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(54) Abstract Title: **Vehicle steering aid system**

(57) A vehicle steering aid system, predominantly for use with a vehicle 10 and trailer 12 in combination, comprises a control unit, vehicle movement sensors, proximity sensors, video cameras, and a user interface 54. The vehicle movement and proximity sensors enable a digital map of the car surroundings to be formed. The view from the video cameras is displayed on a touch screen 60 which is used to input a desired destination. The control unit then formulates a best route and delivers both visual and audio steering cues via the screen 60 and the indicators 62 64. The inventive concept of this application relates to the provision of steering cues which incorporate a display having a proportional element to indicate the amount of steering required. As the user manoeuvres the vehicle, the digital map and relative position of the vehicle are continually updated and steering correction cues are delivered at appropriate points via the interface. The user may indicate the desired direction using the switches 68 70 72. The user interface may also be mounted on a mirror.

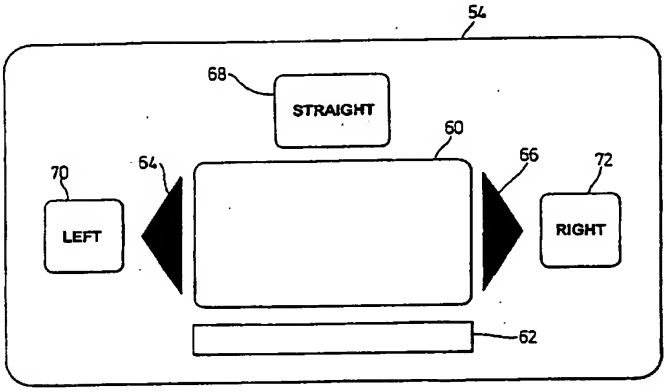

Fig. 2

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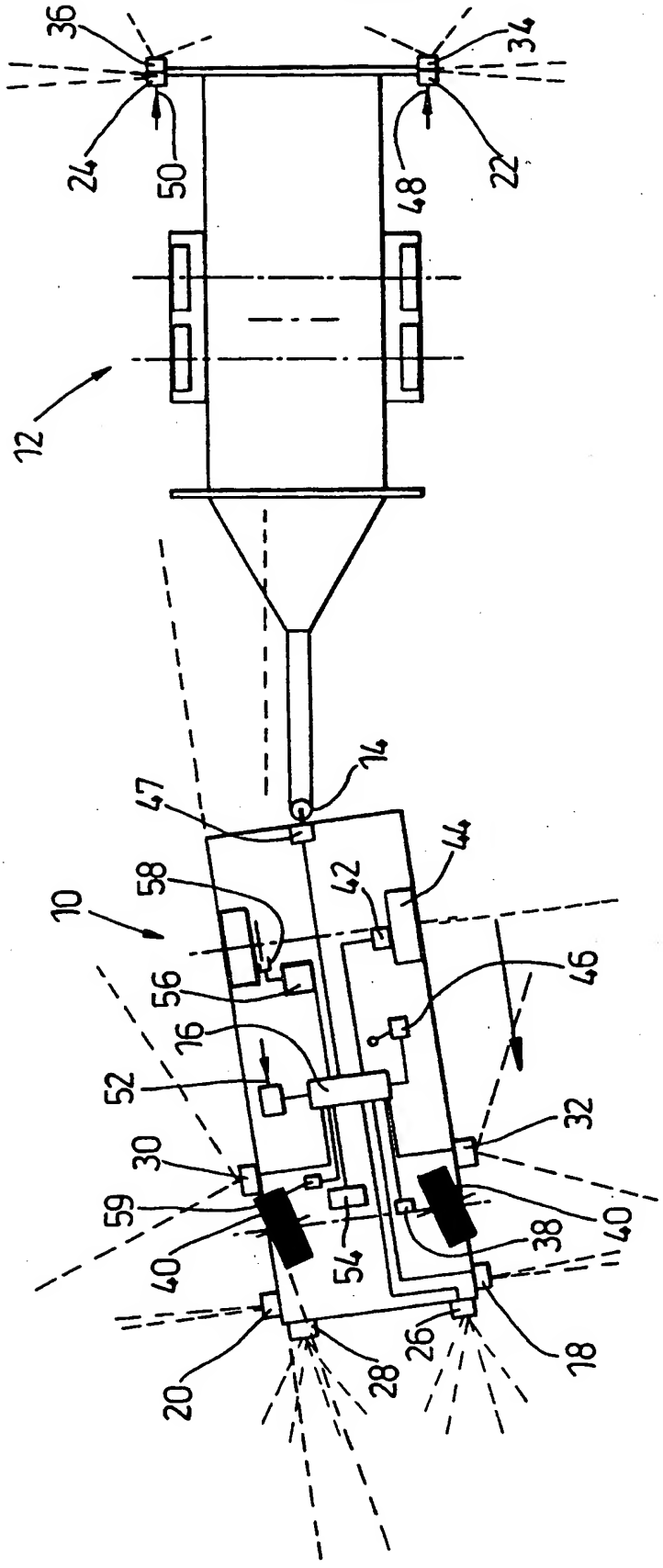
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Fig. 1

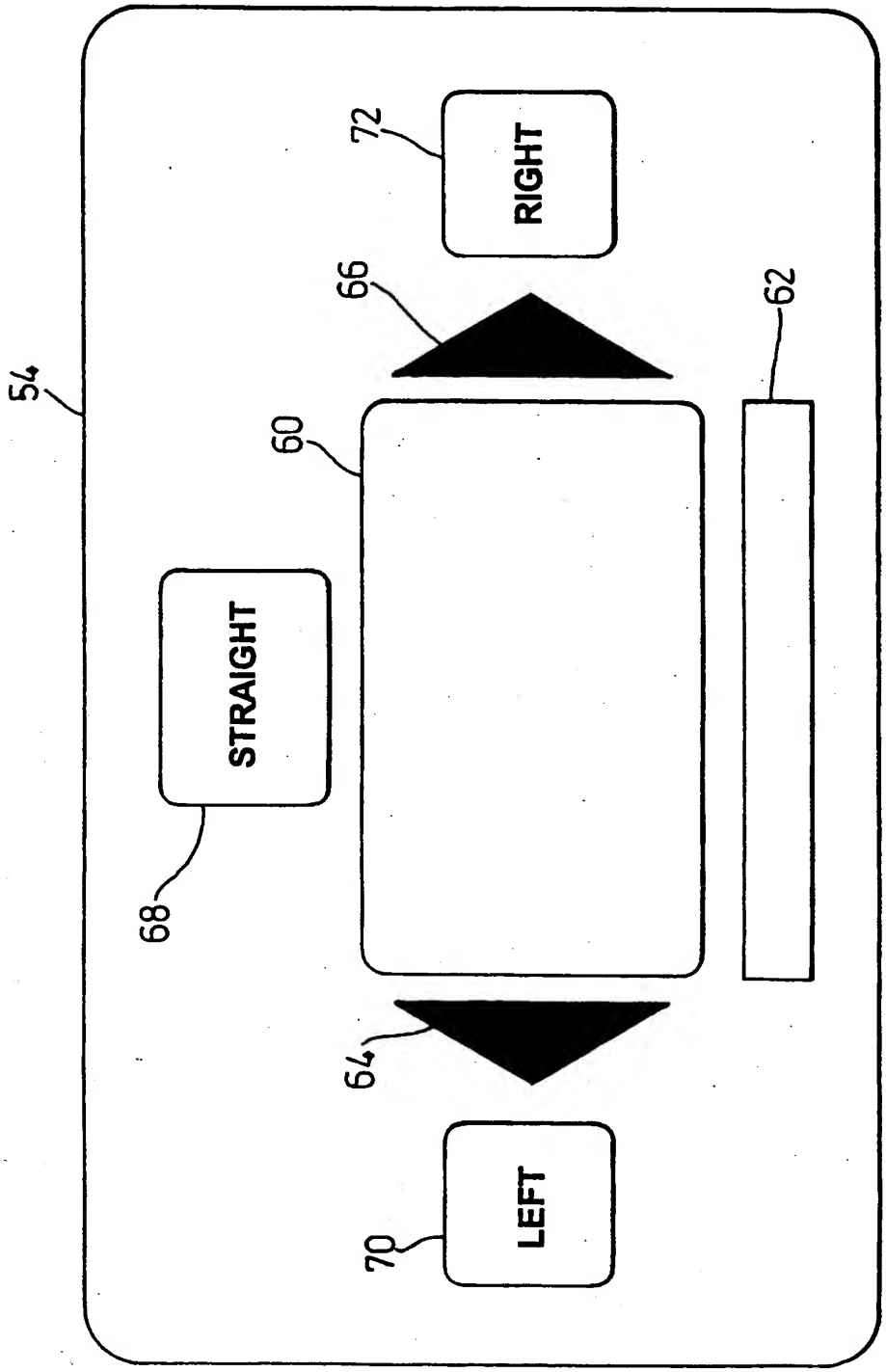
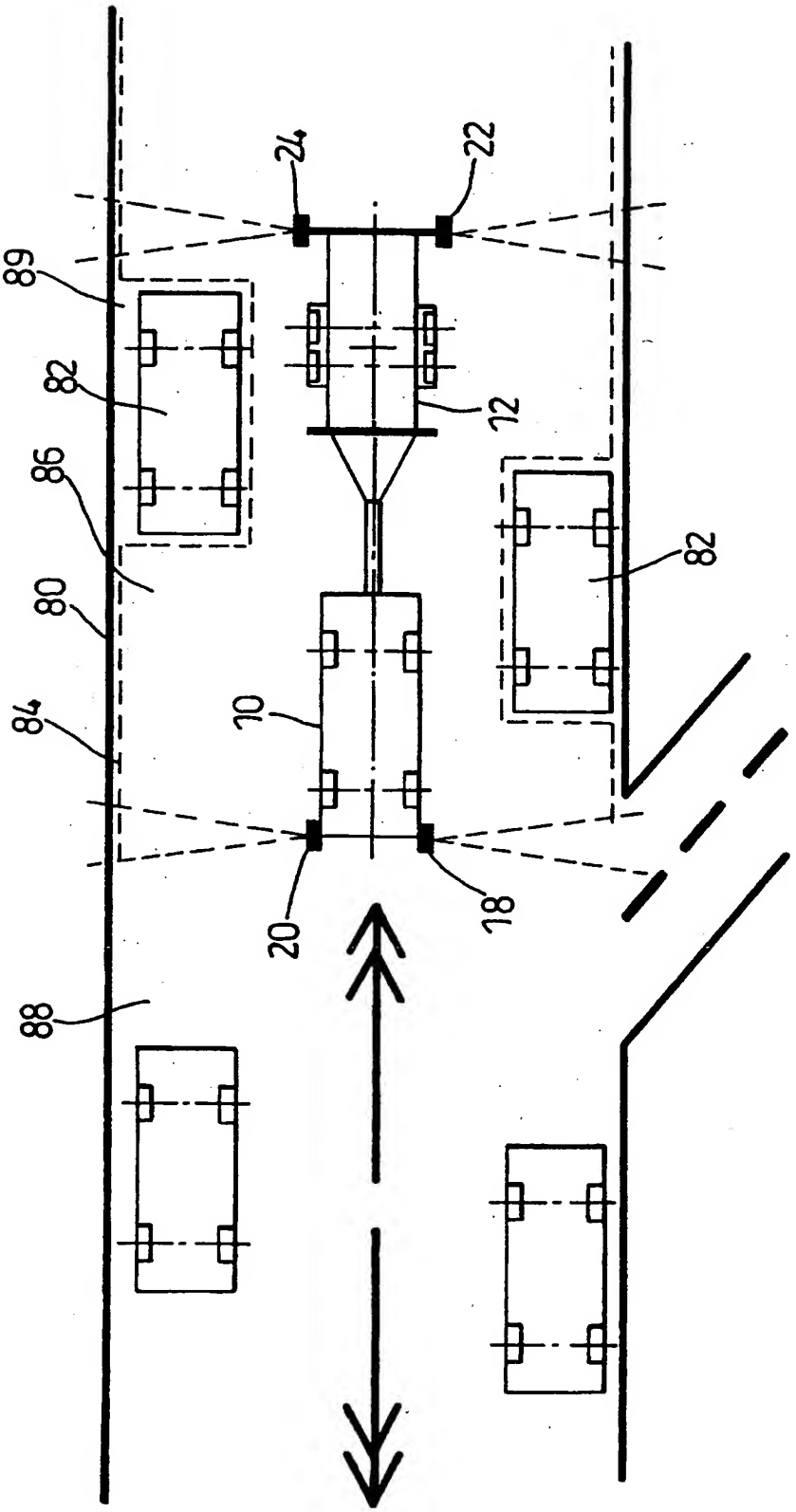


Fig. 2



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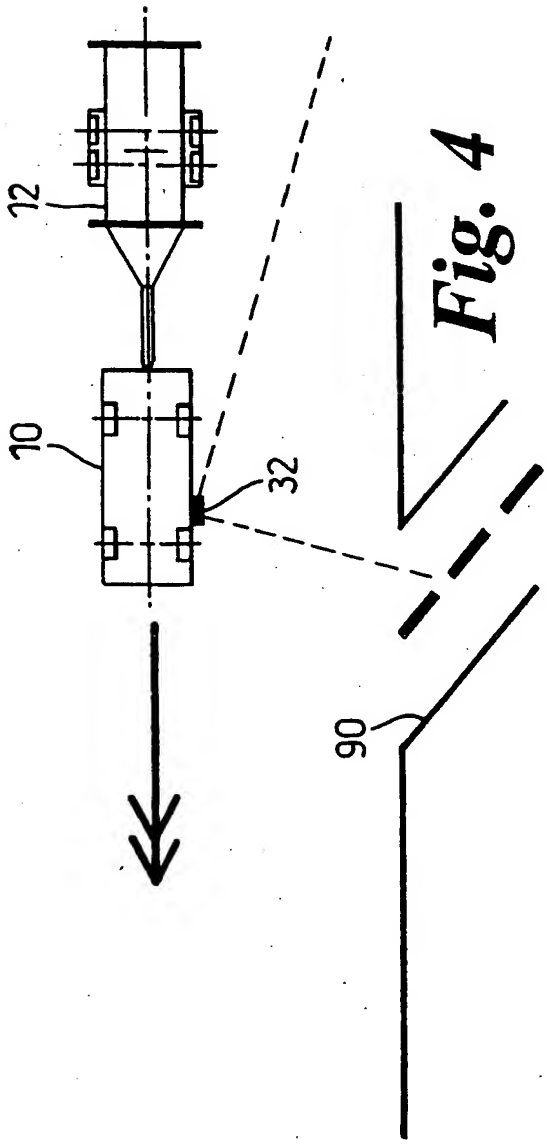

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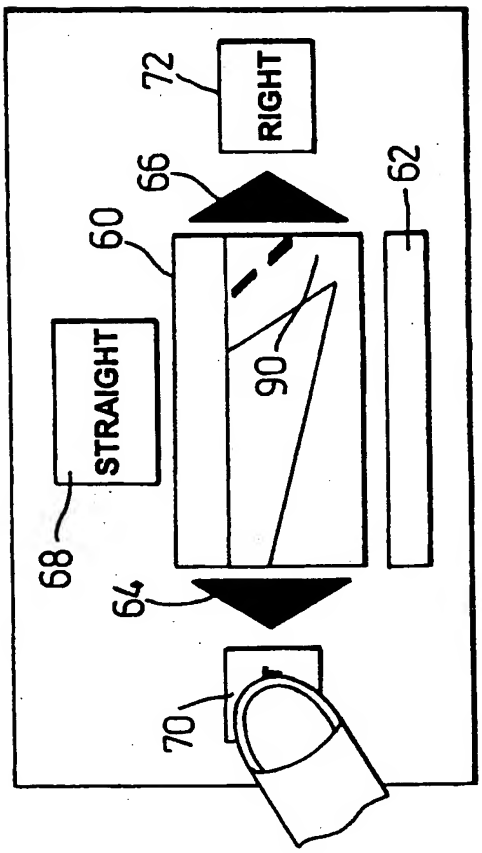

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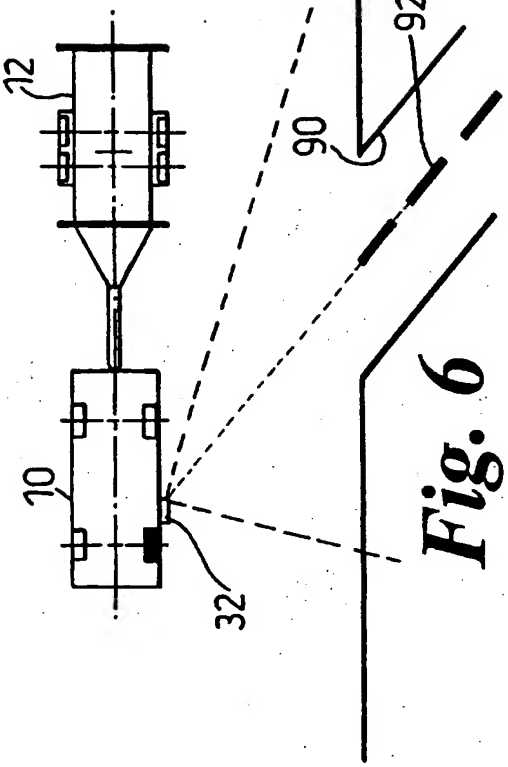

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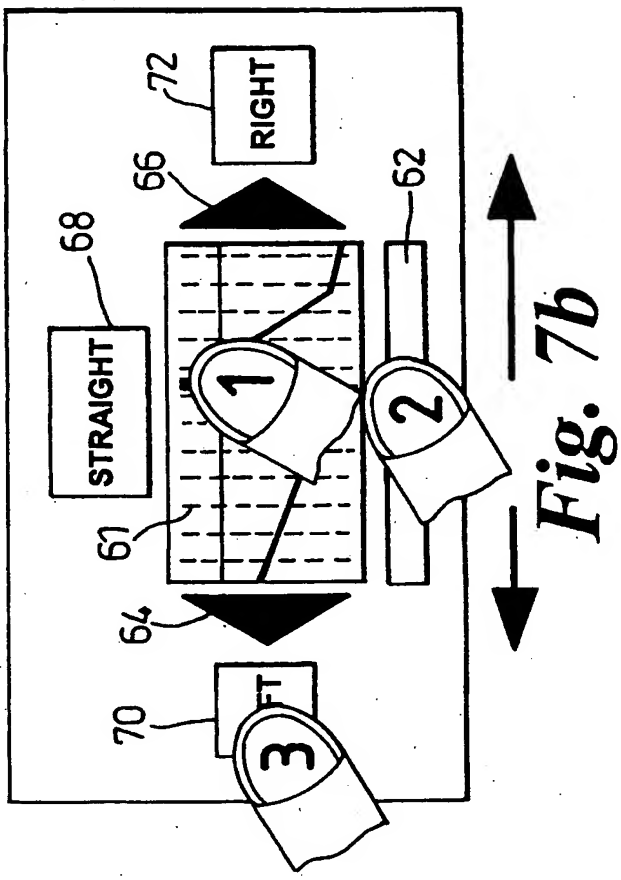

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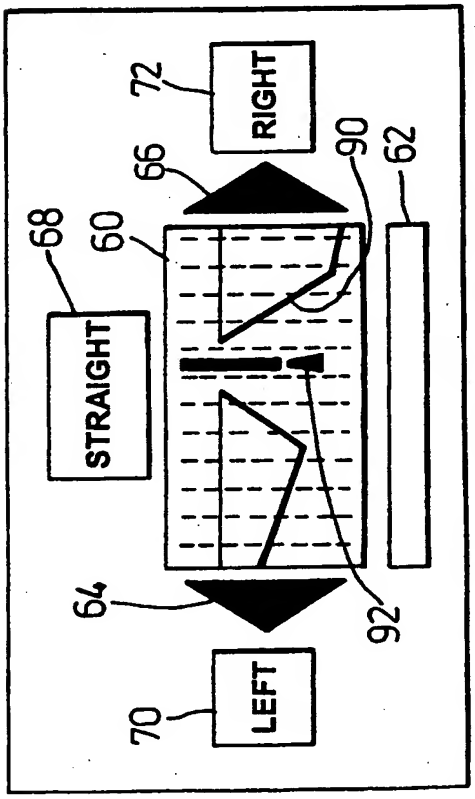

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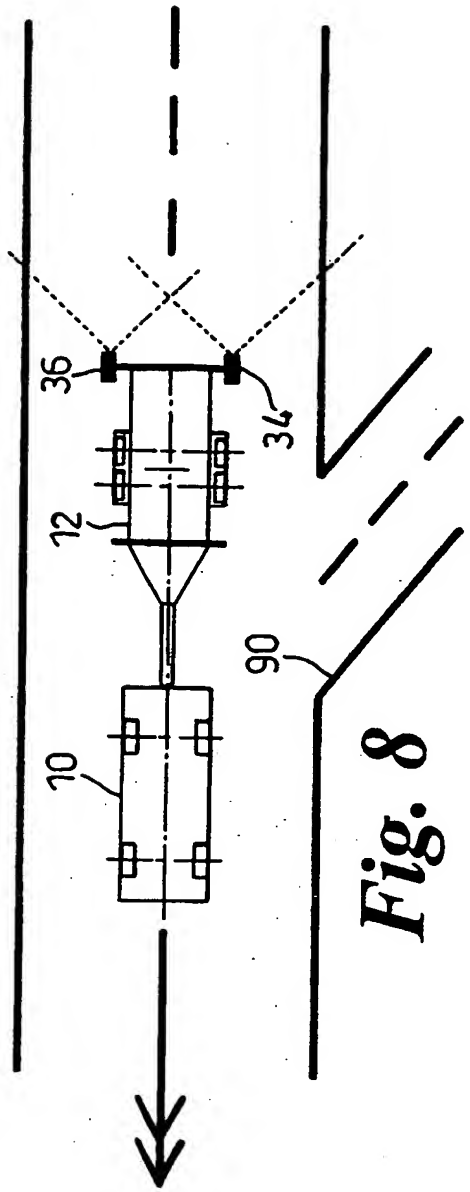

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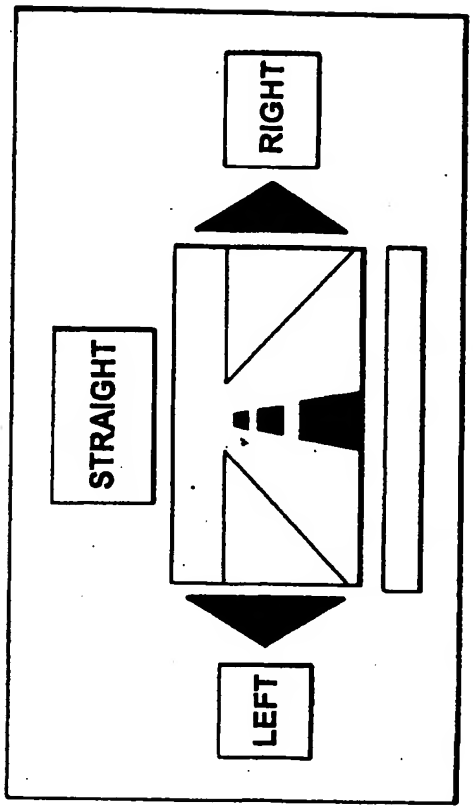

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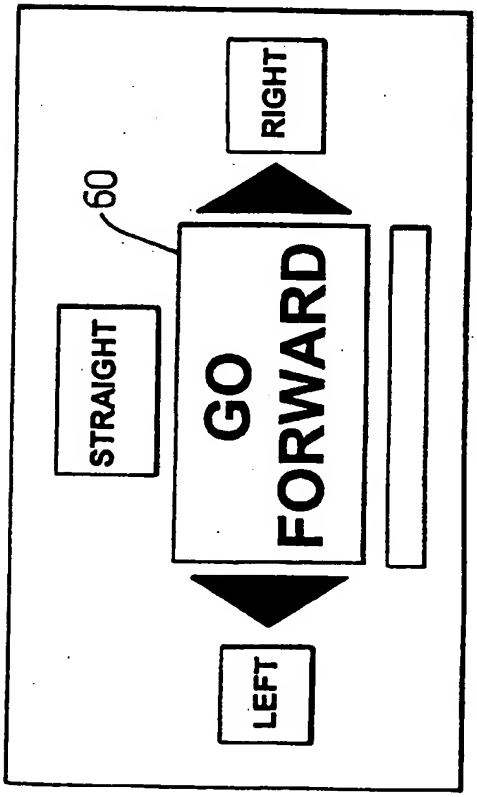

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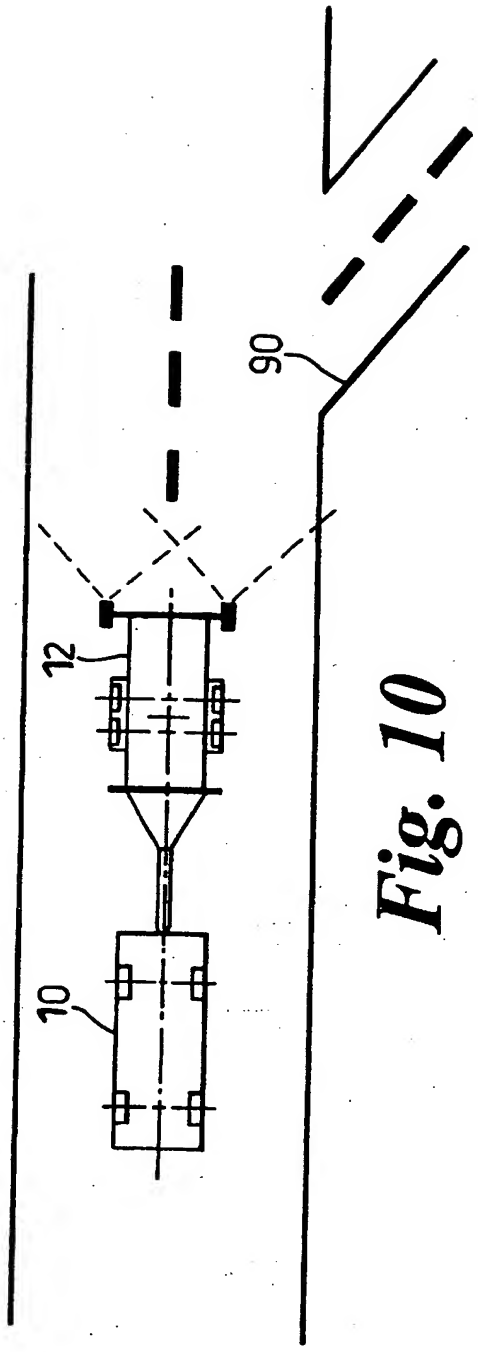

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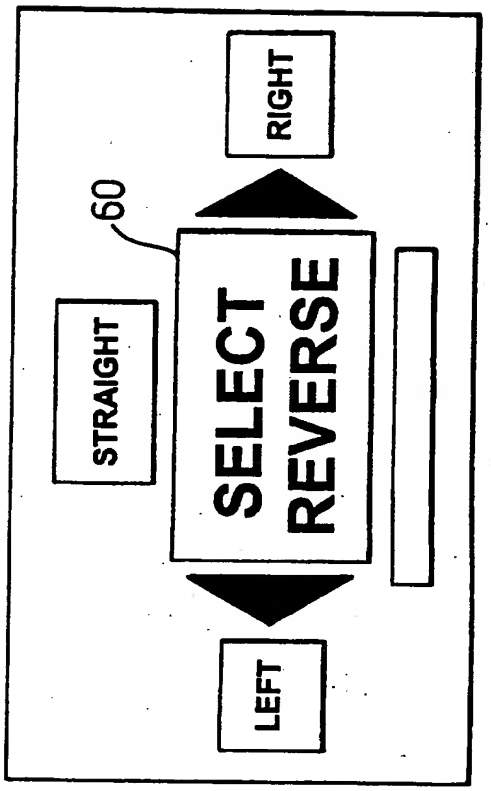

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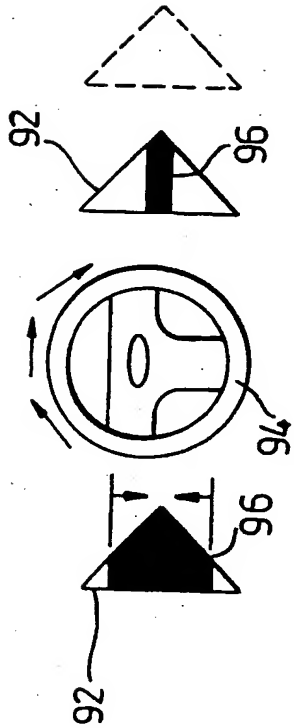

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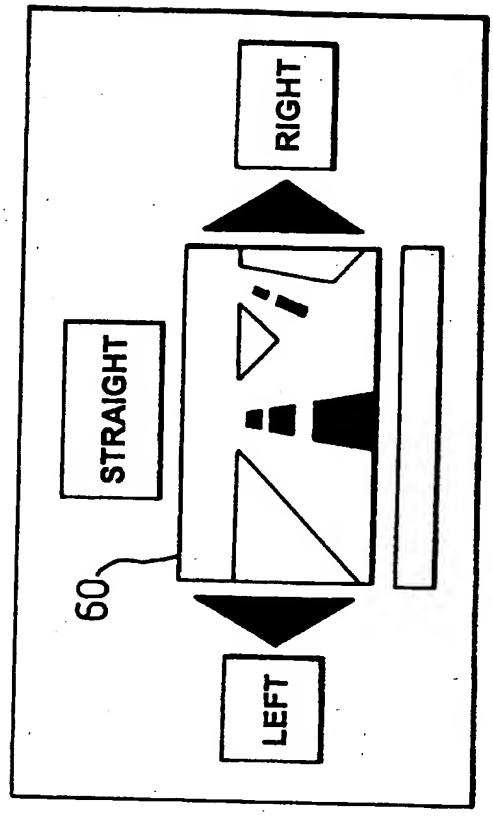

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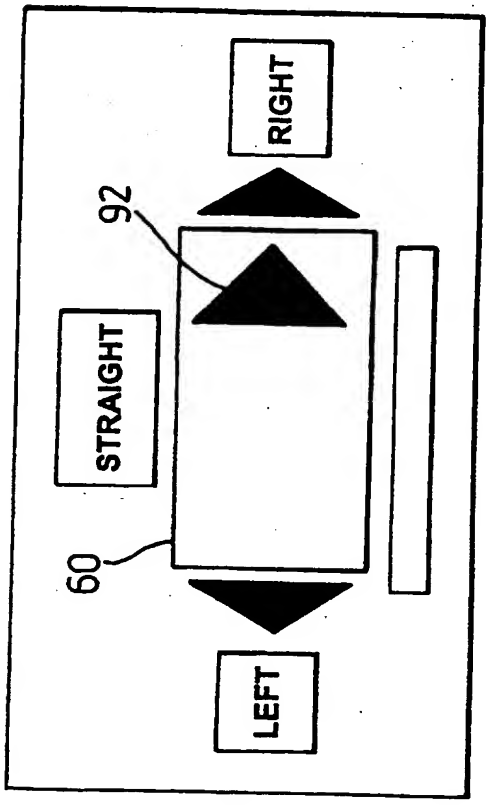

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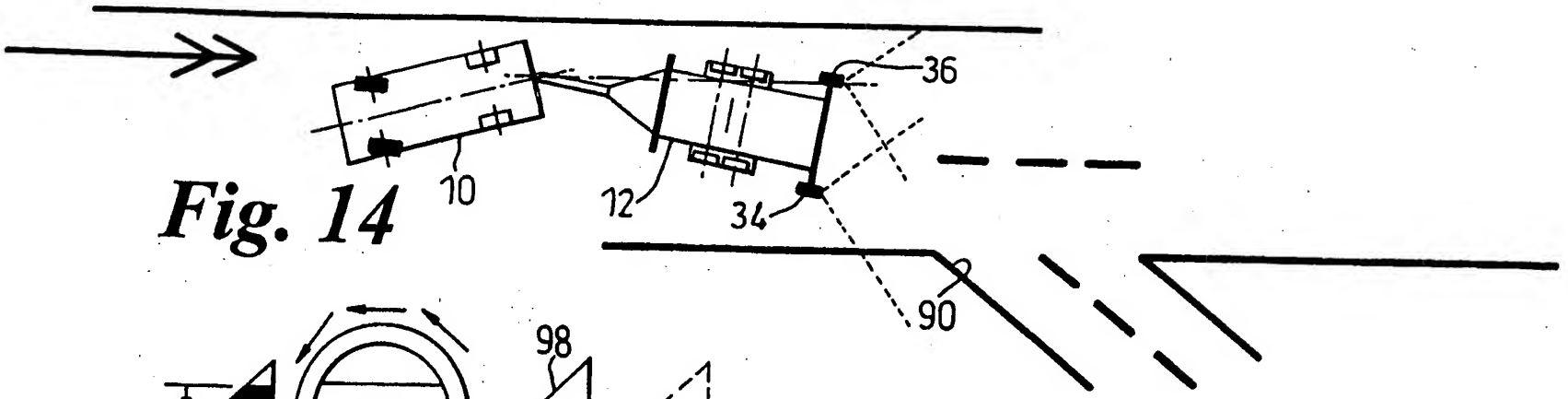

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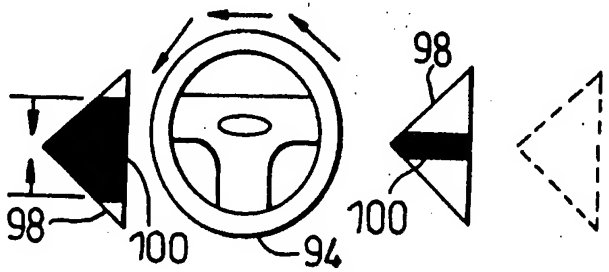

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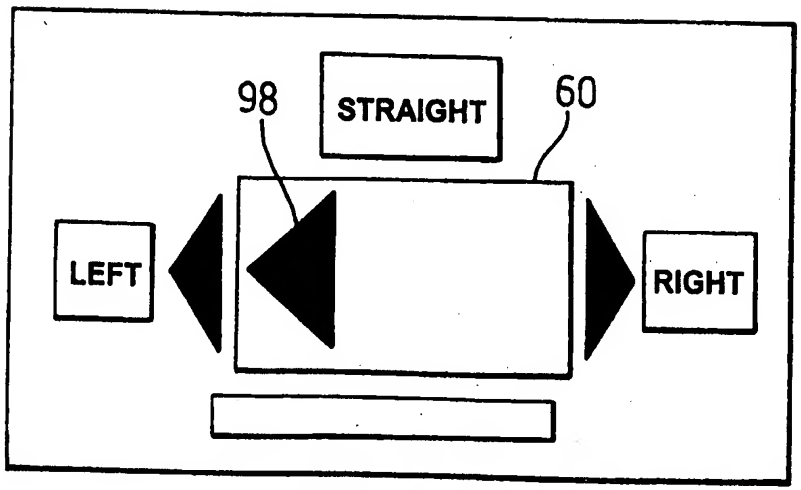

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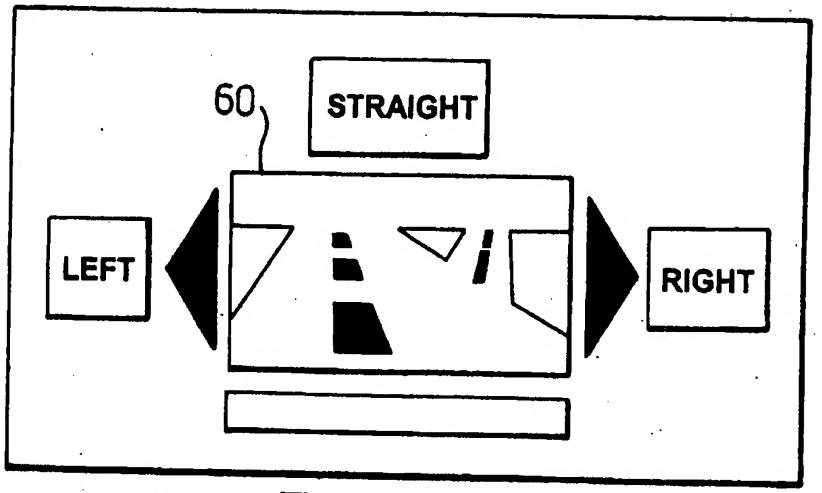

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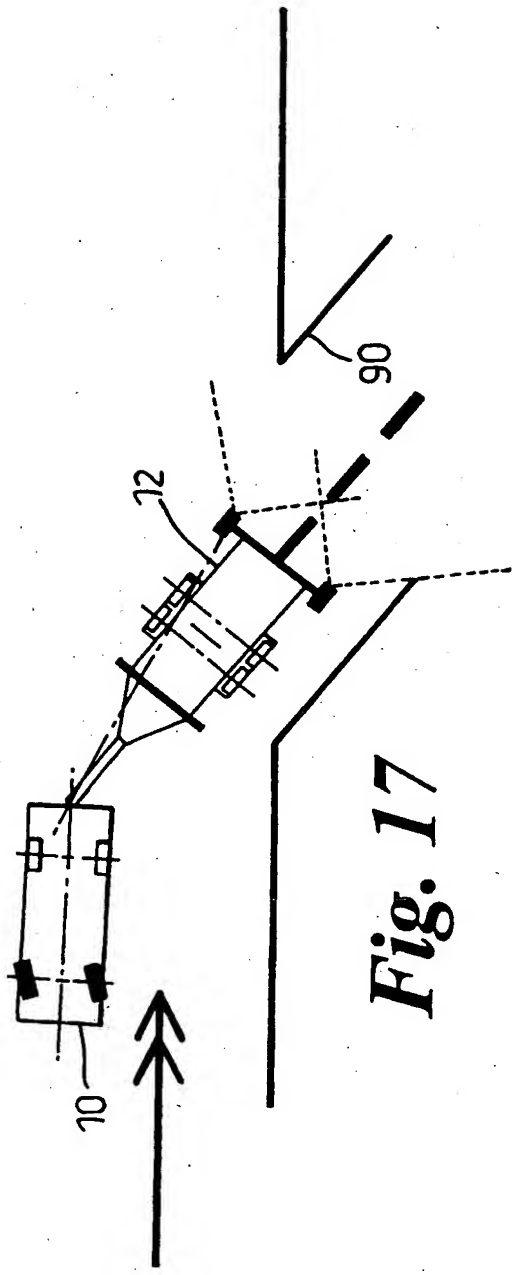

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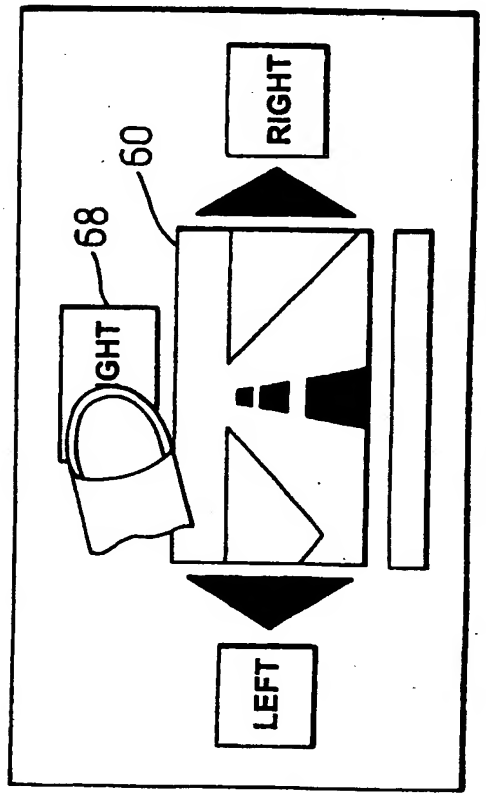

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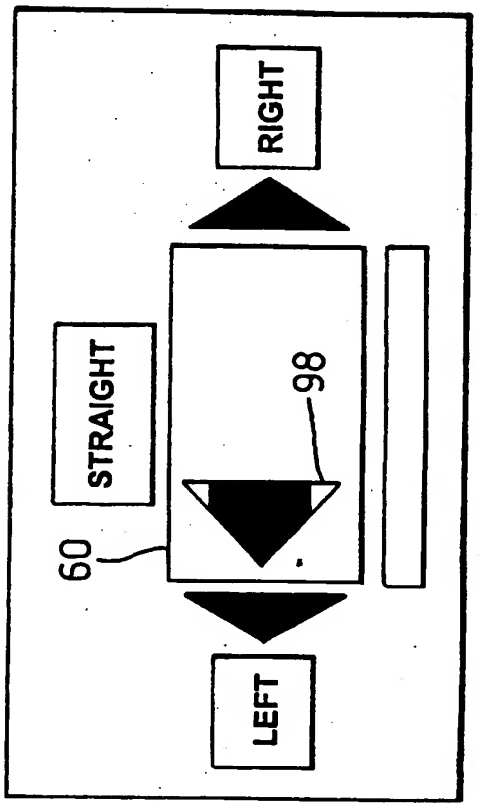

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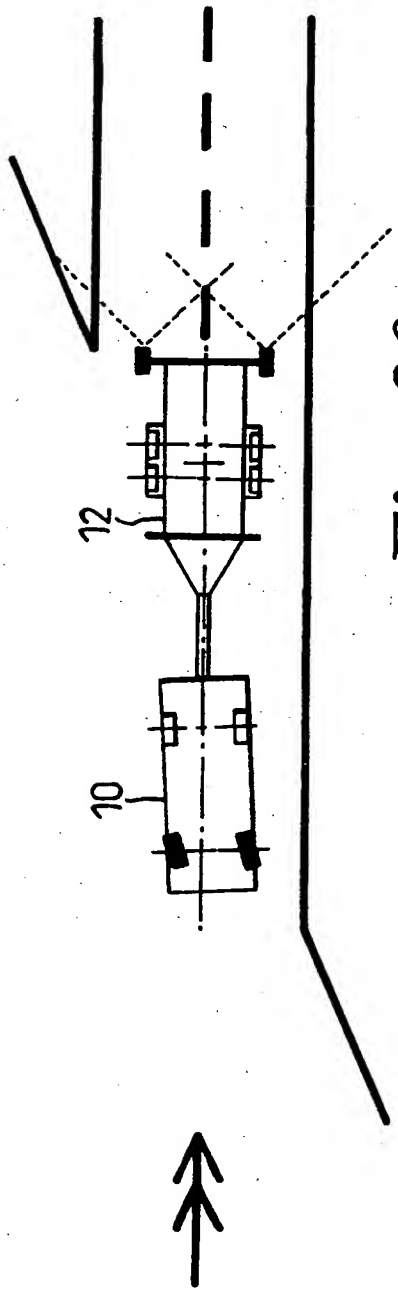

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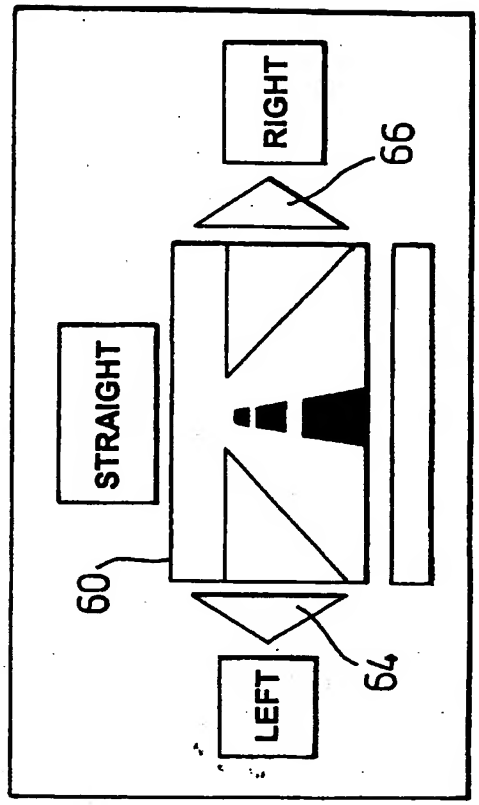

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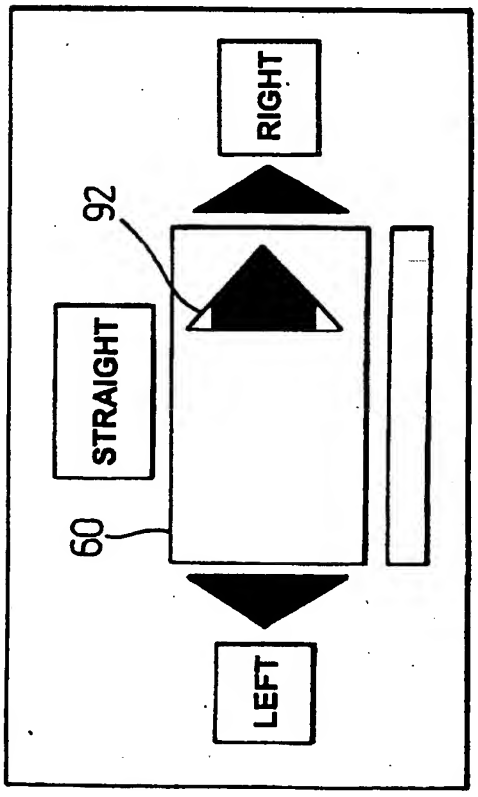

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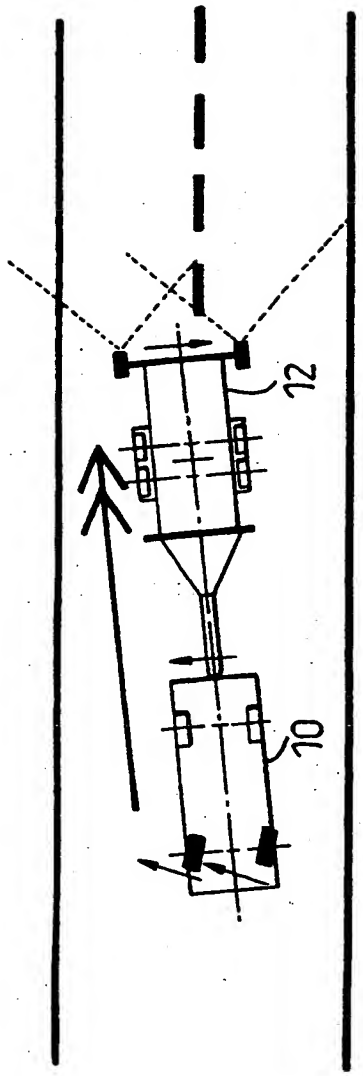

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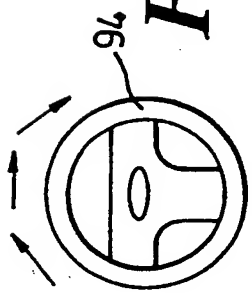

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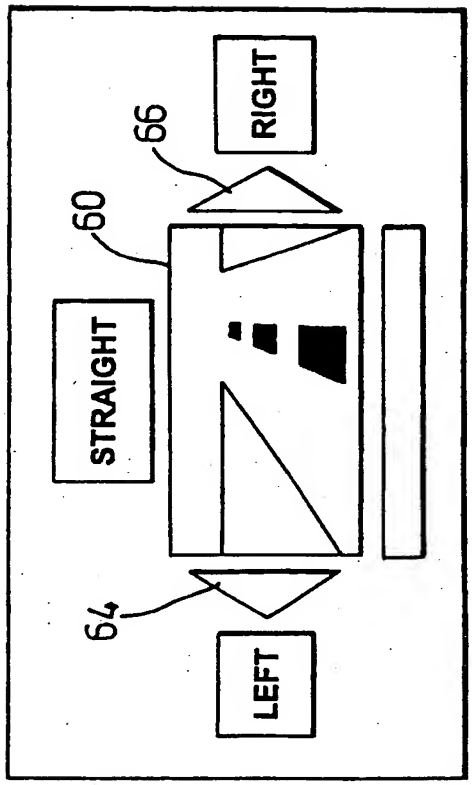

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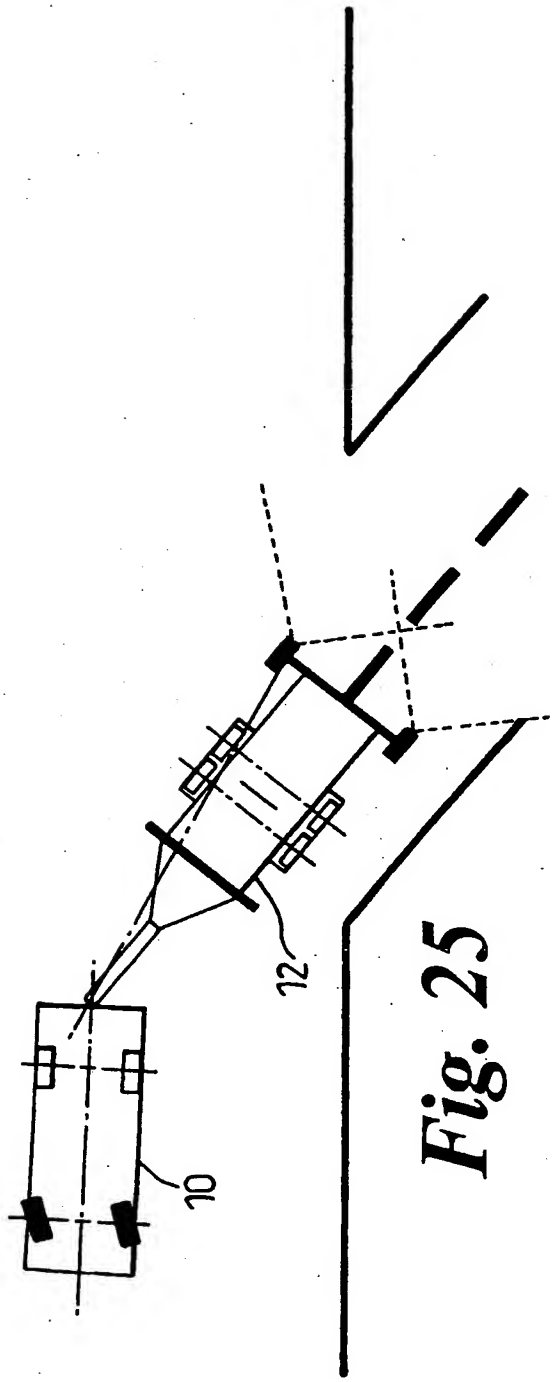

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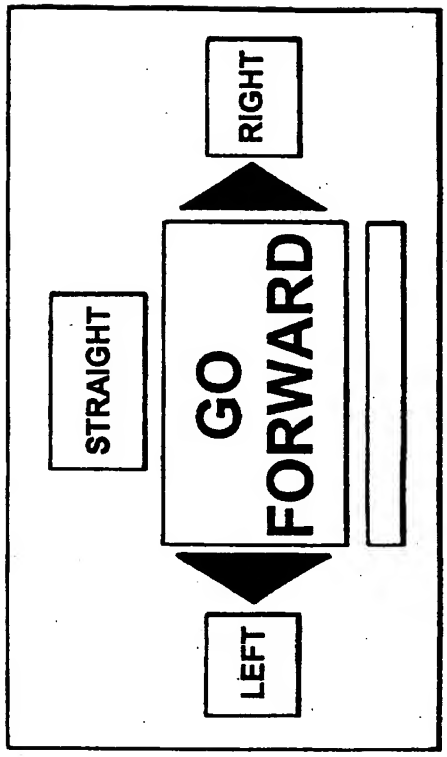

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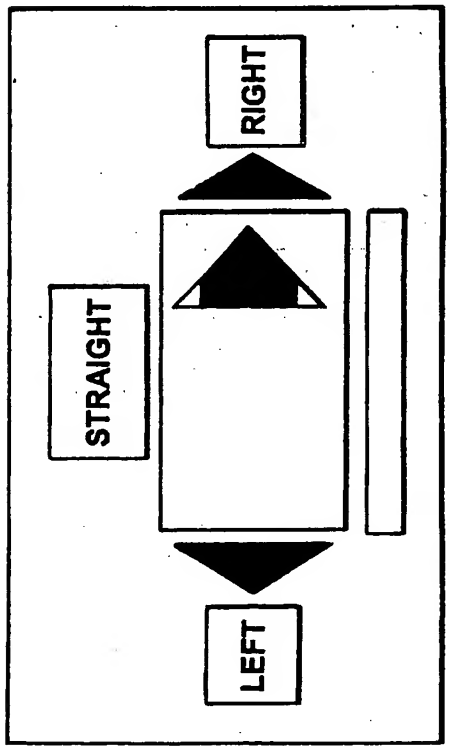

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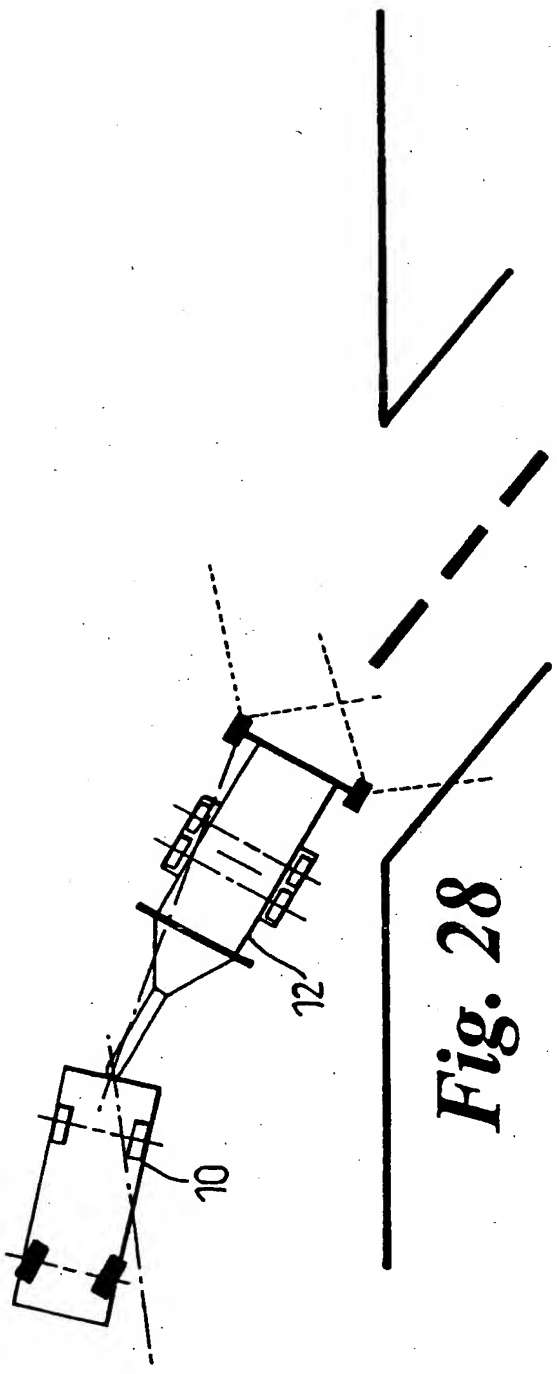

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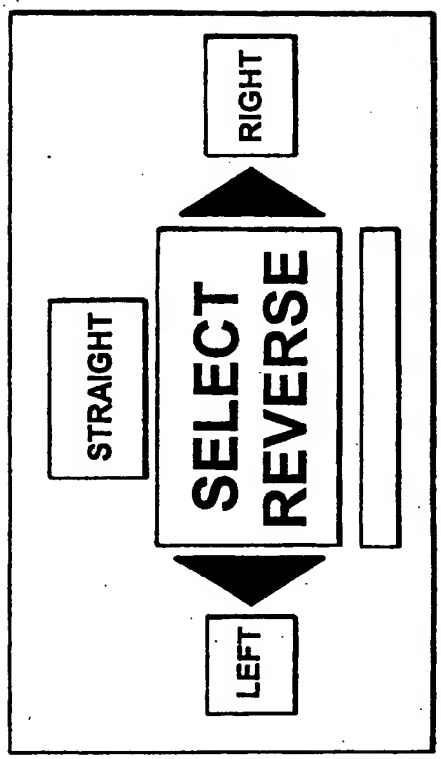

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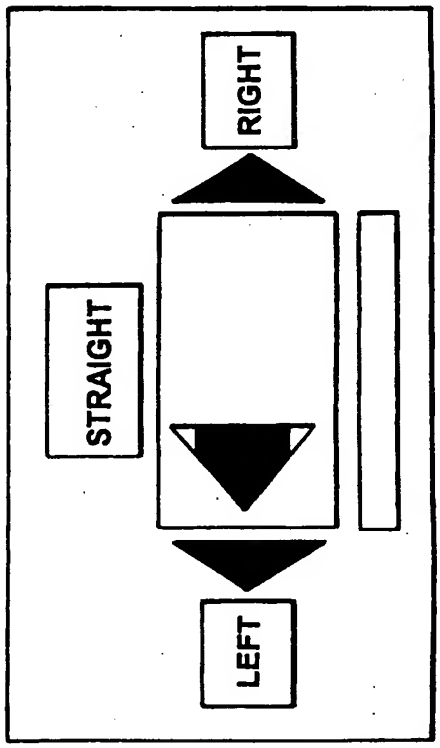

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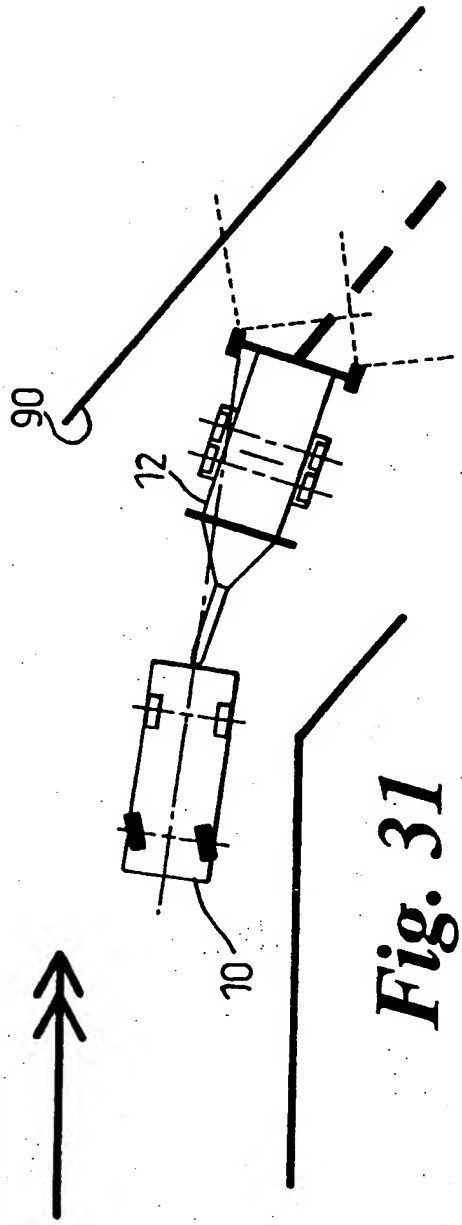

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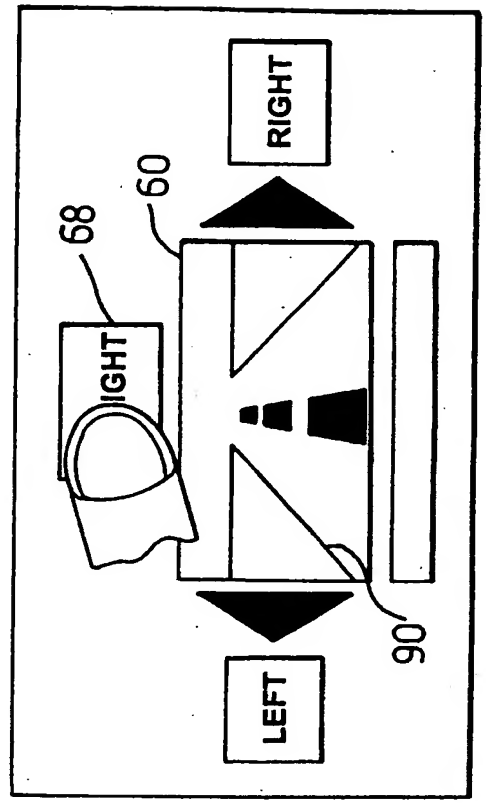

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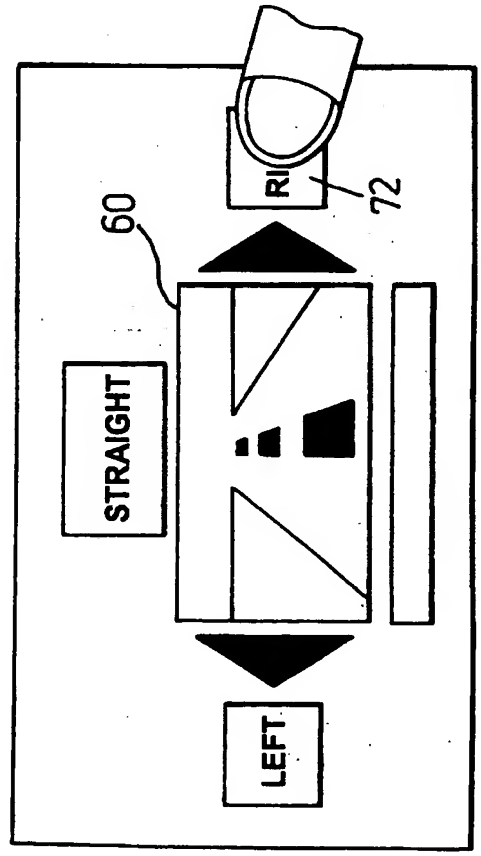

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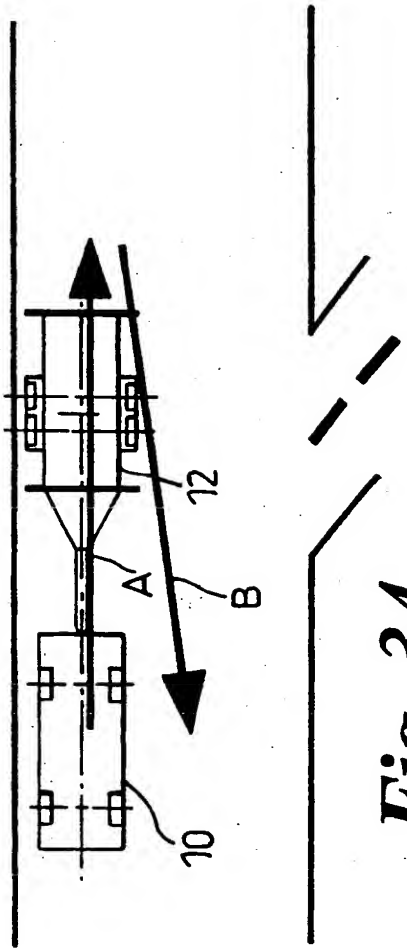

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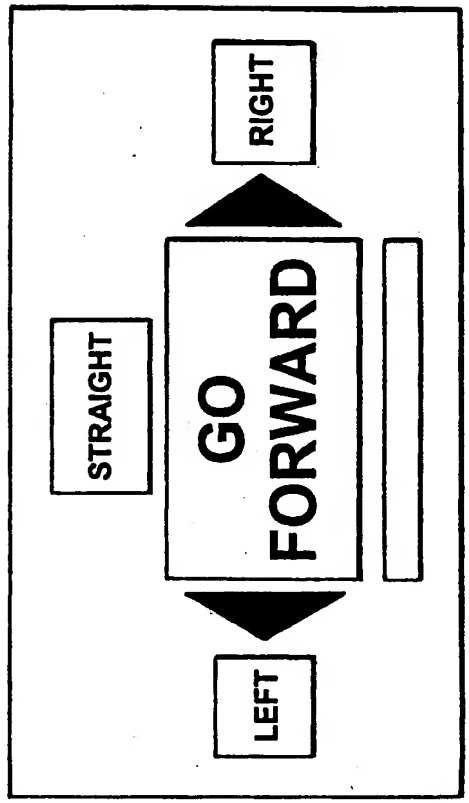

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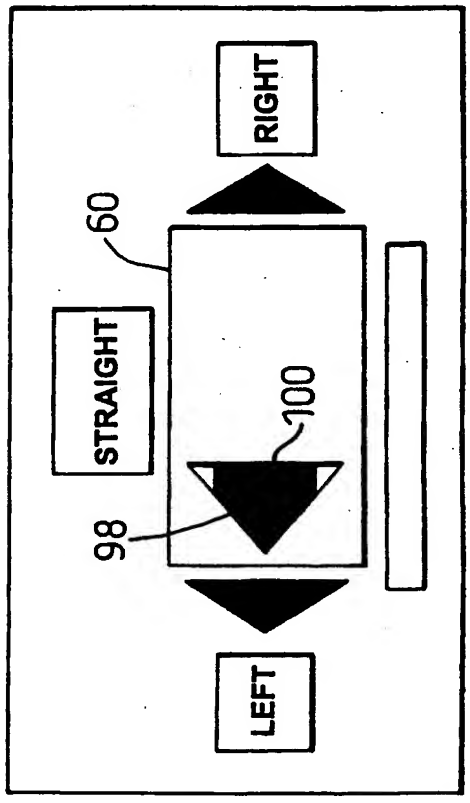

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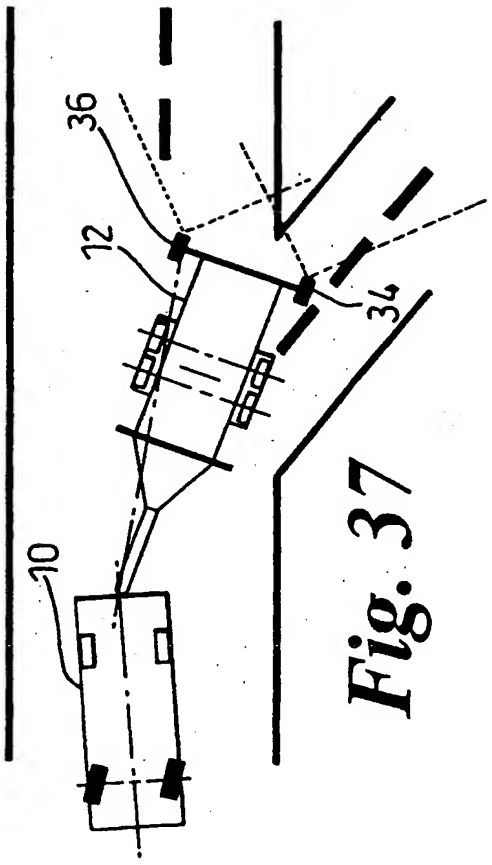

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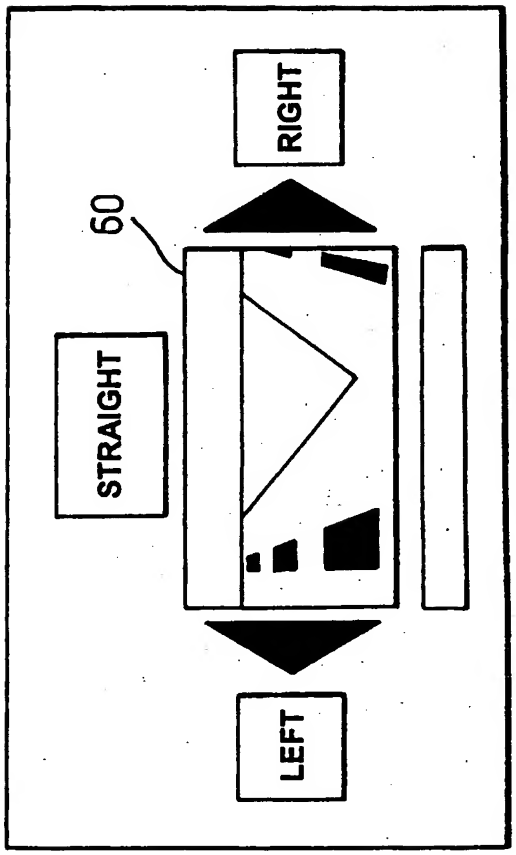

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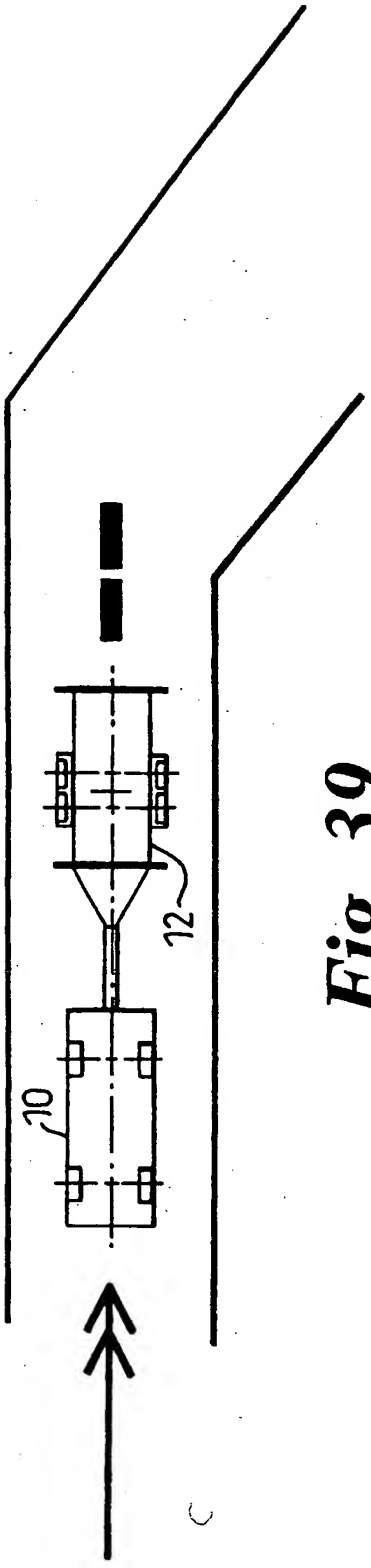

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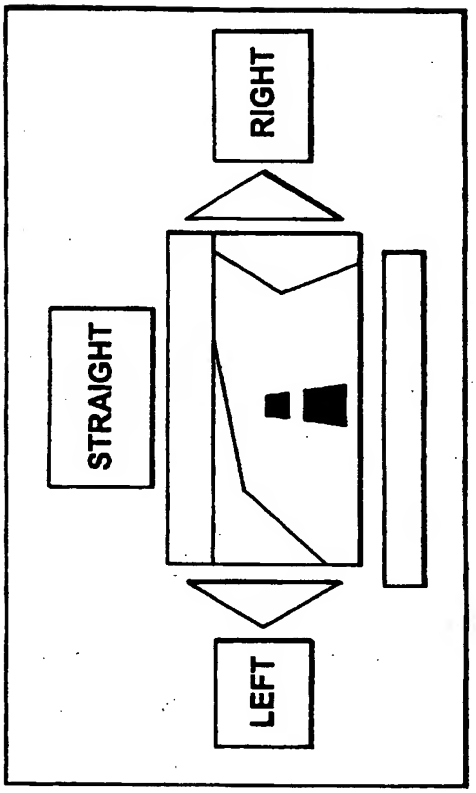

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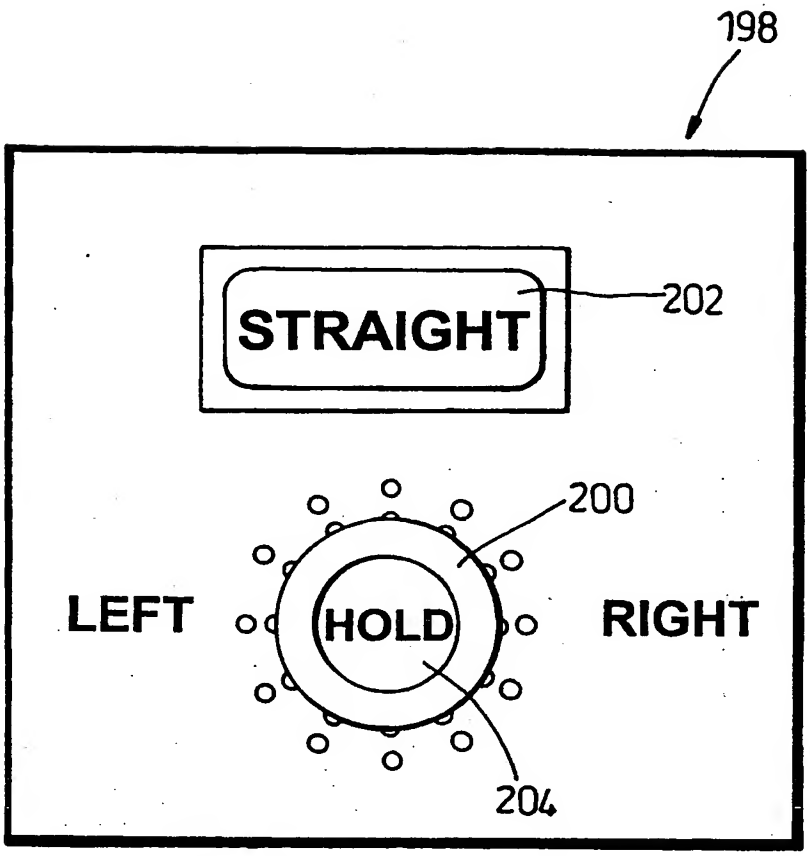

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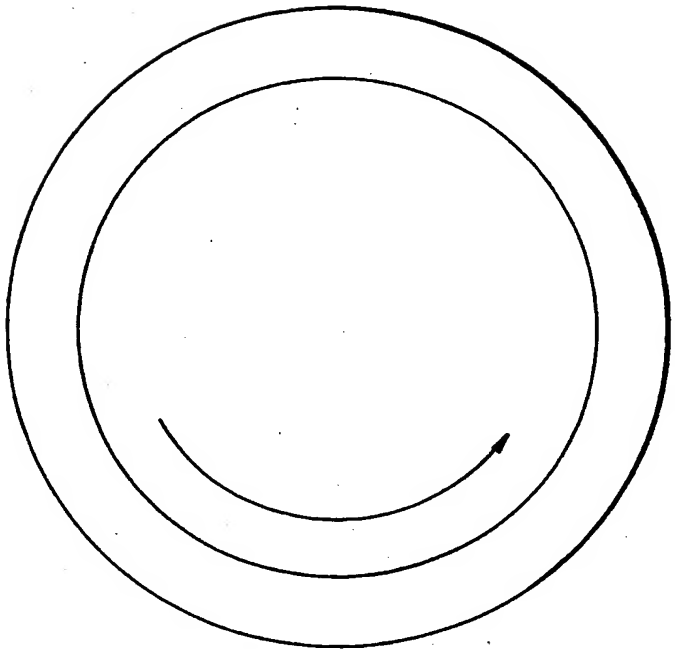

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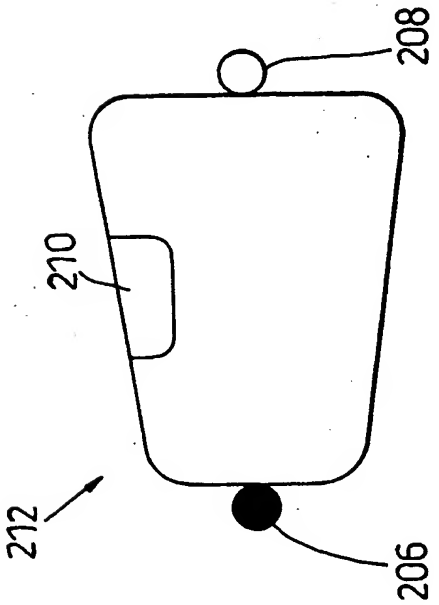

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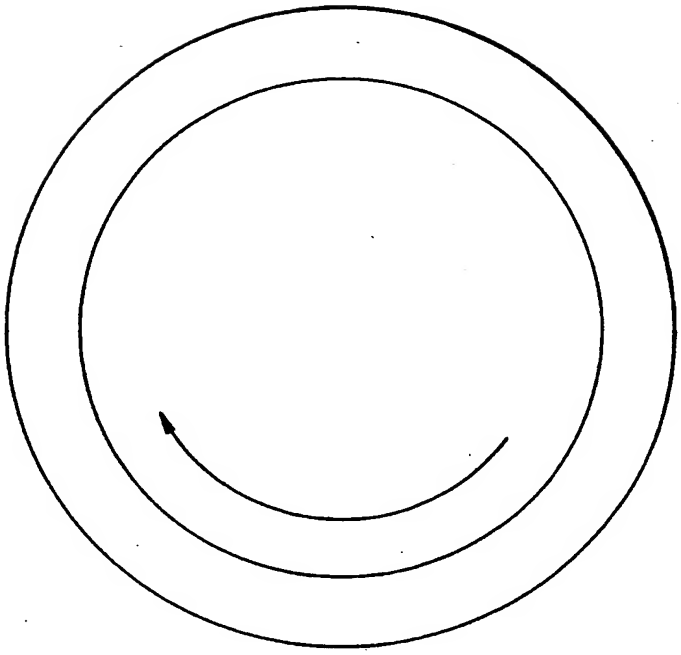

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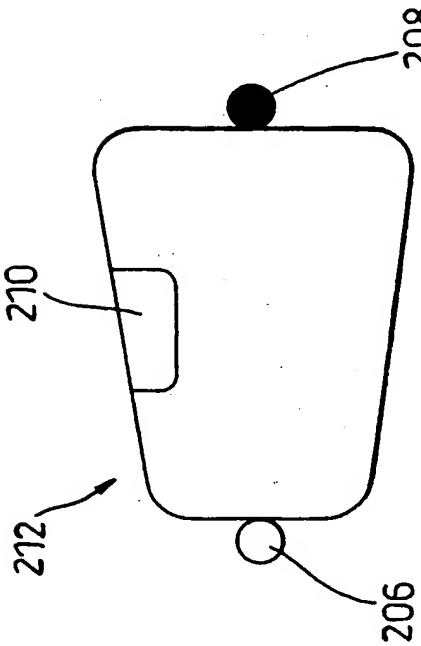

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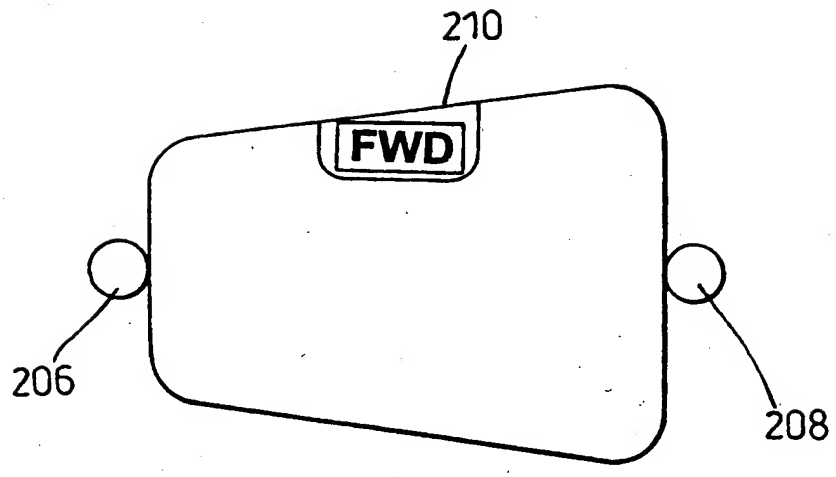

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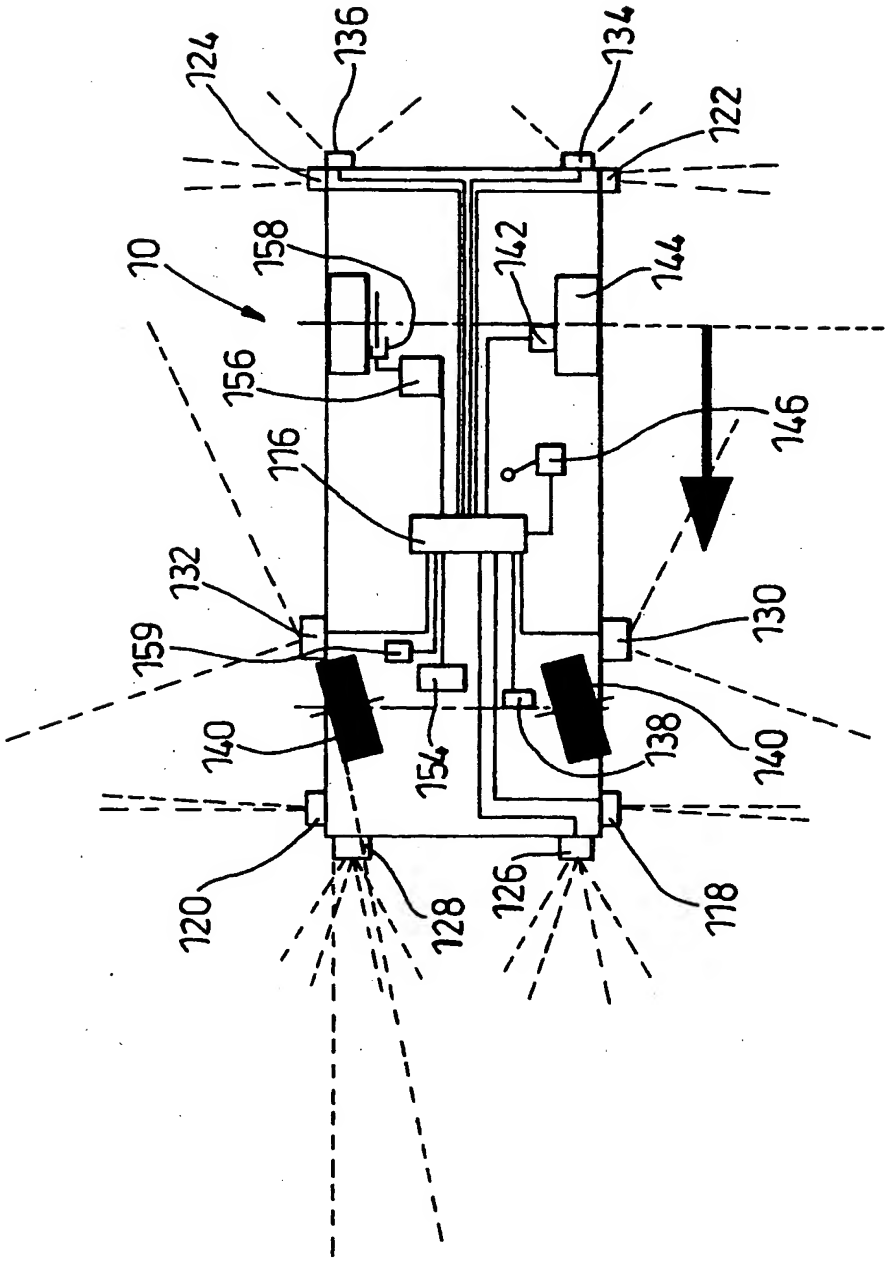
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Fig. 45

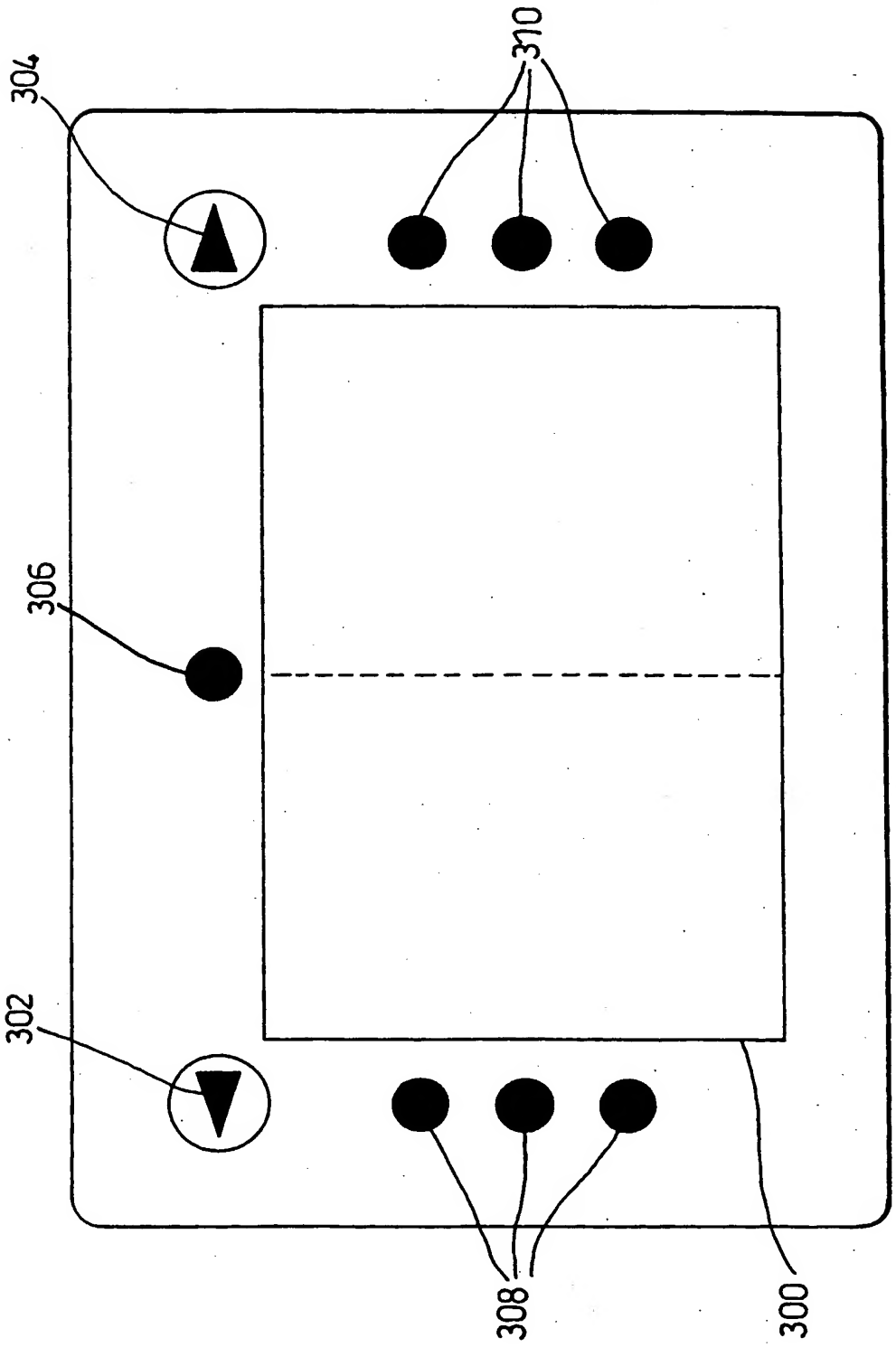

Fig. 46

VEHICLE STEERING AIDS

This invention relates to vehicle steering aids and in particular to aids arranged to help a driver steer a vehicle with or without a trailer into a desired position.

According to the invention there is provided a vehicle steering aid system including display means for indicating to a driver of the vehicle an action to be performed in order to perform a desired manoeuvre, a camera arranged to provide a camera view of the vehicle's surroundings, wherein the display means is arranged to display the camera view and steering correction cues, the steering correction cues being arranged to provide an indication to the driver of the direction of steering required when the vehicle is reversing to align the vehicle in a required direction, by means of reference to the camera view, and wherein the steering correction cues include a proportional element to indicate the amount by which the vehicle's steering wheel should be turned to perform the desired manoeuvre.

The steering correction cues may include any, or a combination of lights, light emitting diodes or liquid crystal displays.

The vehicle steering aid system may be arranged to operate during a reversing manoeuvre and in particular may be used with a vehicle-trailer combination. A camera or a plurality of cameras may be mounted on the trailer, and are most preferably rearwardly facing.

The steering correction cues may be in the form of selectively illuminated arrows preferably pointing to the left and to the right of the driver. The proportional element may comprise a band provided within each arrow, the width of the band preferably being proportional to, or otherwise indicating,

the amount by which the steering wheel should be turned to perform the desired manoeuvre.

Alternatively the steering correction cues may be in the form of a plurality of selectively illuminated left indicator lights and a plurality of right indicator lights. The proportional element may be provided by the illumination of a differing number of lights, for example a single illuminated light may indicate a lesser degree of turning of the steering wheel required than a plurality of illuminated lights.

Preferably the steering correction cues are provided on the display screen.

The display means may further be arranged to display a gear selection cue to indicate to the driver the desired direction of travel of the vehicle to perform the desired manoeuvre, namely forwards or backwards, in a reverse gear. The gear selection cue may comprise words, such as "straight" and "reverse".

The display means may be mounted on external mirrors of the vehicle. Preferably the display means is provided inside the vehicle, for example on an interface accessible by the driver.

Preferred embodiments of the present invention will now be described by way of example only with reference to the accompanying drawings in which: -

Figure 1 is a diagram of a vehicle and trailer including a steering aid according to a first embodiment of the invention;

Figure 2 shows a driver interface forming part of the system of Figure 1;

Figure 3 illustrates a mapping function of the system of Figure 1;

Figure 4 shows the vehicle of Figure 1 approaching a target entrance;

Figure 5 shows operation of the interface when the vehicle is in the position of Figure 4;

Figure 6 shows the vehicle of Figure 1 aligned with the target entrance of Figure 4;

Figure 7a shows the display on the interface when the vehicle is in the position of Figure 6;

Figure 7b shows user inputs to the interface when the vehicle is in the position of Figure 6;

Figure 8 shows the vehicle of Figure 1 in position to start an initial forward movement step of the vehicle positioning;

Figure 9a shows the display when the vehicle is in the position of Figure 8;

Figure 9b shows the display following the start of the initial forward movement step of the vehicle positioning;

Figure 10 shows the vehicle of Figure 1 in position to start reversing into the target entrance of Figure 4;

Figure 11 shows the interface when the vehicle is in the position of Figure 10;

Figure 12 shows the display while the driver is preparing to reverse into the target entrance;

Figure 12a illustrates the meaning of the display of Figure 12;

Figure 13 shows the display when the vehicle is ready to start reversing into the target entrance;

Figure 14 shows the vehicle reversing towards the target entrance;

Figure 15 shows the display when the vehicle is in the position of Figure 14;

Figure 15a shows the meaning of the display of Figure 15;

Figure 16 shows the display when the vehicle is again ready to reverse;

Figure 17 shows the vehicle of Figure 1 with the trailer aligned in the target entrance;

Figure 18 shows the driver input when the vehicle is in the position of Figure 17;

Figure 19 shows the display after the driver input of Figure 18;

Figure 20 shows the vehicle and the trailer aligned in the target entrance;

Figure 21 shows the display when the vehicle is in the position of Figure 20;

Figure 22 shows the display when the vehicle is in the position of Figure 20 and the steering angle is zero;

Figure 23 shows the vehicle of Figure 1 reversing in a straight line;

Figure 24 shows the display when the vehicle is reversing in a straight line;

Figure 24a shows the correction operation required when the vehicle is in the position of Figure 23;

Figure 25 shows the vehicle of Figure 1 with the trailer at a large angle to the vehicle;

Figure 26 shows the display when the vehicle is in the position of Figure 25;

Figure 27 shows the display when the vehicle is in the position of Figure 25 and the driver has chosen the required steering angle;

Figure 28 shows the vehicle of Figure 1 recovering from the trailer angle of Figure 25;

Figure 29 shows the display when the vehicle is in the position of Figure 28;

Figure 30 shows the display when the vehicle is in the position of Figure 28 and the driver has chosen the required steering angle;

Figure 31 shows the vehicle of Figure 1 in a position where the trailer angle needs correction;

Figure 32 shows the user inputs to make the steering correction required in Figure 31;

Figure 33 shows the user inputs required when the steering correction required in Figure 31 has been completed;

Figure 34 shows the vehicle of Figure 1 in a position where lateral repositioning is required;

Figure 35 shows the display when the vehicle is in the position of Figure 34;

Figure 36 shows the display when the vehicle is in the position of Figure 34 and the correct steering angle has been selected;

Figure 37 shows the vehicle of Figure 1 in a position where the target entrance has been missed;

Figure 38 shows the display when the vehicle is in the position of Figure 37;

Figure 39 shows the vehicle of Figure 1 reversing towards a corner;

Figure 40 illustrates use of fixed cues on the display of the system of Figure 1.

Figure 41 shows a driver interface forming part of a steering aid system according to a second embodiment of the invention;

Figure 42a shows a display means prompting a driver to turn left according to the system of the second embodiment;

Figure 42b illustrates the meaning of the display in Figure 42a;

Figure 43a shows the display of Figure 42a prompting a driver to turn right;

Figure 43b illustrates the meaning of the display in Figure 43a;

Figure 44 shows the display of Figure 42 prompting the driver to drive forwards;

Figure 45 shows a vehicle according to a third embodiment of the invention; and

Figure 46 shows a driver interface forming part of a steering aid system according to a fourth embodiment of the invention.

Referring to Figure 1, a vehicle 10 has a trailer 12 coupled to a towball 14 on its rear end so that the trailer can pivot about the towball 14 in conventional manner. The vehicle is equipped with a reversing aid system which is controlled by a control unit 16. Two front lateral distance sensors 18, 20 are mounted on the vehicle, one on each side near the front of the vehicle, and pointing laterally so that they can measure the distance to objects to either side of the vehicle 10. Two rear distance sensors 22, 24 are mounted on the rear of the trailer, one on each side of the trailer and also pointing laterally so that they can measure the distance to objects to either side of the trailer 12. The vehicle also includes forwards looking distance

sensors 26, 28 mounted on the front of the vehicle. Two side view video cameras 30, 32 are mounted one in each of the vehicle wing mirrors, and are angled so that each of them is pointing in a direction to the side of the vehicle and slightly to the rear. Two further rear view video cameras 34, 36 are mounted on the rear of the trailer, one on each side, pointing to the rear. The control unit 16 is also connected to a steering angle sensor 38 arranged to measure the steering angle of the front steered wheels 40 of the vehicle 10, a wheel sensor 42 in the form of a rotation sensor mounted on the rear propshaft to monitor the rotation of rear wheel 44 and arranged to measure the distance the vehicle moves, a gear sensor 46 arranged to detect which gear the vehicle gearbox is in, and in particular whether it is in reverse or a forward gear, and a trailer angle sensor 47 arranged to measure the angle between the trailer and the vehicle. RF transmitters 48, 50 are arranged to transmit signals from the rear distance sensors 22, 24 and the rear video cameras 34, 36, and an RF receiver 52 is connected to the control unit 16 to enable it to receive signals from the rear distance sensors 22, 24 and the rear video cameras 34, 36. A user interface 54 is provided in the vehicle, connected to the control unit 16 to allow the driver to receive instructions from the system and provide inputs to it. The control unit 16 is also connected to a vehicle brake control unit 56 which in turn controls operation of the vehicle's brakes 58, only one of which is shown in Figure 1. An audible alarm 59 is also provided in the vehicle 10 connected to the control unit 16 and is able to provide warning signals and prompts at various stages of the vehicle positioning manoeuvres as required.

Referring to Figure 2, the user interface 54 comprises a rectangular touch sensitive screen 60, a long horizontal touch sensitive pad 62 below the screen 60, and two arrows 64, 66 one on each side of the screen 60 pointing away from it in opposite directions to form fixed cues, the operation of which will be described below. There are also three switches: a 'straight' switch 68 above the screen 60, a 'left' switch 70 to the left of the screen and a 'right' switch 72 to the right of the screen 60. The screen 60, pad 62

and the switches 68, 70, 72 allow the user to give inputs to the system to indicate where he wants the vehicle 10 and trailer 12 combination to go, and the screen 60 and the fixed cues 64, 66 give directions to the driver as to how to control the vehicle to reach the desired position.

Referring to Figure 3, whenever the vehicle is moving forwards below a predetermined speed of 15 kph, the front and rear lateral sensors 18, 20, 22, 24 are activated and the control unit 16 uses the signals from them to monitor the distance of the nearest obstacle to either side of the vehicle. The lateral sensors 18, 20, 22, 24 are arranged so that they can detect kerbs 80 as well as other vehicles 82. They are also arranged to be able to detect other obstacles such as lamp posts, and temporary signs in the road. As the vehicle 10 and trailer 12 combination moves forwards the control unit 16 uses the signals from the lateral sensors 18, 20, 22, 24 together with the wheel sensors 42, to generate a map of obstacles 80, 82. The map includes a boundary line 84 between areas 86 of the road 88 which are free from obstacles and where the trailer 12 or vehicle 10 can move, and areas 89 which are taken up by obstacles 80, 82 and where the trailer 12 or vehicle 10 cannot safely move. As the vehicle moves the map is retained for a moving window of a predetermined length, in this case of 20m, of the road along which the vehicle 10 and trailer 12 have most recently travelled.

As well as storing the map, the control unit 16 also continuously monitors the position of the vehicle 10 and the trailer 12 within the area defined by the map. It can do this using the wheel sensors 42, the steering angle sensor 38 and the towbar angle sensor 47. The length of the vehicle 10 and the trailer 12 is also known. This ensures that the control unit 16 can always determine where the vehicle 10 and trailer 12 are relative to the various obstacles 80, 82 in the currently stored map, and hence where they will be able to move without colliding with one of the mapped obstacles.

Also while the vehicle 10 is moving forwards, the forward-looking sensors 26, 28 continuously monitor for obstacles in the path of the vehicle.

If an obstacle is detected and the vehicle speed and direction of travel are such that the vehicle is likely to collide with the obstacle, the control unit 16 sends a signal to the brake control unit 56 which actuates the vehicle's brakes 58 so as to bring the vehicle to a gentle halt.

When, as shown in Figure 4, the vehicle 10 approaches an entrance 90 that the driver would like to reverse the vehicle 10 and trailer 12 into, he can activate the reversing aid system by pressing one of the 'left' switch 70 and 'right' switch 72, which will cause the view from the relevant side view video camera 30, 32, which in this case is the left side view camera 32, to be displayed in the screen 60. This view will, provided the vehicle is close enough to the entrance 90, include a view of the entrance 90 as shown in Figure 5.

Referring to Figure 6, in order to indicate to the system where the target entrance 90 is, the driver moves the vehicle 10 forwards until the entrance 90 is aligned with the left side view video camera 32 as shown in Figure 7a. It will be appreciated that, when the video image on the screen 60 includes a view directly down the centreline 92 of the entrance 90, then the position of the centreline 92 on the screen 60 will depend on the position and angle of the entrance 90. Therefore, in order to target the entrance 90, the user first touches the screen 60, as indicated at 1 in Figure 7b, which introduces a cursor 94 onto the screen 60. He then moves the cursor 94 along the screen 60 until it is in line with the entrance centreline 92. This can be done by moving his finger along the touch sensitive pad 62 as indicated at 2 in Figure 7b. Then, when the cursor 94 is aligned with the entrance 90, the position of the entrance 90 is entered in the system by pressing the 'left' switch 70 as indicated at 3 in Figure 7b.

Referring to Figure 8, once the target entrance has been identified, the driver then needs to drive the vehicle 10 and trailer 12 combination forwards so as to be able to start to reverse into the entrance 90. In order to initiate this, the screen 60 displays an instruction to go forward, as shown

in Figure 9a and the audible alarm 59 sounds once to prompt the driver. The control unit also stores the current position of the entrance 90 on the map, together with the positions of the vehicle 10, which it has continuously monitored, and the trailer 12 which it can determine from the towbar angle. Then, when the driver responds to this command and the vehicle 10 starts to move forward, the screen 60 shows the view from the rear view cameras 34, 36 as shown in Figure 9b. The control unit 16 also continues to map any obstacles that the vehicle 10 passes as it continues to move forwards. The control unit also monitors the position of the vehicle 10 and the trailer 12 so that it can determine their positions relative to each other and to the entrance 90 and any obstacles 80, 82. Since the control unit 16 is continually processing this information, there is no requirement for the driver to drive forwards in a straight line.

Referring to Figure 10, when the vehicle 10 and trailer 12 combination reach a position from which it will be possible to reverse into the entrance 90 without the vehicle or trailer hitting any obstacles identified in the map, the control unit 16 sends a signal to the brake control unit 56 which operates the vehicle brakes 58 to bring the vehicle 10 to a gentle halt. The audible alarm 59 again sounds once, and the screen 60 displays an instruction to the driver to select reverse gear as shown in Figure 11. Then when reverse gear has been selected a single sound of the alarm 59 alerts the driver to commence the next action, and the screen 60 displays an indication, in the form of an arrow 92 as shown in Figure 12, indicating the direction in which the driver needs to turn the steering wheel 94 to steer the vehicle towards the target entrance 90. As shown in Figure 12a, the arrow pointing to the right indicates that the driver needs to turn the steering wheel to the right. It will be appreciated that steering to the right, away from the entrance 90, will be needed first to start the trailer 12 turning towards the entrance 90. Also a coloured band 96 in the middle of the

arrow 92 is arranged to change in width, a broad band 96 indicating that a large change in steering is required, and a narrow band 96 indicating that only a small change in steering angle is required. When the steering angle is correct and the vehicle 10 and trailer 12 combination is steering towards the entrance 90, the screen 60 once again shows the view from the rear view cameras 34, 36 as shown in Figure 13. If while the driver is changing the steering angle he moves the steering wheel in the wrong direction, the audible alarm 59 sounds repeatedly and the arrow 92 flashes on and off.

Referring to Figure 14, when the vehicle 10 has reversed for some distance with the steering wheel steering away from the entrance 90, it will reach a position where the steering angle needs to be reversed to start the vehicle 10 and the trailer 12 reversing together towards the entrance 90. This point is determined by the control unit 16 on the basis of the calculated positions of the vehicle 10 and the trailer 12. At this point the brakes 58 are again operated to bring the vehicle 10 to a gentle halt, and the alarm 59 is sounded once to indicate that the driver needs to take action. The screen 60 displays an arrow 98 pointing to the left as shown in Figure 15 indicating that the driver needs to turn the steering wheel 94 to the left. As shown in Figure 15a, the arrow 98 includes a band 100, the width of which indicates the amount by which the steering wheel 94 needs to be turned. When the steering angle is again correct for the reversing to continue, the alarm 59 sounds once and the screen 60 changes again to display the view from the rear view cameras 34, 36 as shown in Figure 16. If, while the driver is changing the steering angle he moves the steering wheel in the wrong direction, the audible alarm 59 sounds repeatedly and the arrow 98 flashes on and off.

Then the reversing continues with any changes in steering angle required being indicated by the right and left arrows 92, 98 as appropriate until the vehicle reaches the position shown in Figure 17 where the trailer 12 is aligned with the target entrance 90. The driver can see that this point has

been reached from the view in the screen 60 as shown in Figure 18 which will be directly along the direction of the target entrance 90. Therefore at this point the driver brakes the vehicle himself and presses the straight switch 68 to indicate to the system that the trailer 12 is pointing in the correct direction. The screen 60 then displays the left arrow 98 again as shown in Figure 19 to indicate that the steering angle needs to be increased to the left so as to allow the vehicle 10 and trailer 12 to straighten up. As the vehicle continues to reverse under the driver's control further steering cues are given using the arrows 92, 98 until the vehicle 10 is almost aligned with the trailer 12 in the target entrance 90 as shown in Figure 20. The brakes are then controlled by the control unit 16 to bring the vehicle 10 to a halt, and the alarm 59 sounded once to indicate that further action is required. The right arrow 92 is then displayed as shown in Figure 21 to indicate that the steering wheel 94 needs to be turned to the right to straighten it. When this has been done, the rear view is again displayed on the screen as shown in Figure 22 and the fixed cue arrows 64, 66 become illuminated continuously. The reverse turning manoeuvre is then complete.

Referring to Figure 23, the driver can then continue to reverse the vehicle 10 and trailer 12 in a straight line, using the illuminated fixed cues 64, 66 to indicate the required changes in steering direction. For example, if as shown in Figure 23, the trailer 12 is pointing to the right of the required direction of travel, the view of the road in the rear view display of the screen 60 will move to the right as shown in Figure 24, towards the right fixed cue arrow 66. This can be used as a cue by the driver to turn the steering wheel 94 to the right as shown in Figure 24a, turning the front wheels to the right as shown in Figure 23, which is the correct way to straighten the combination 10, 12. Then, as the trailer straightens, the view of the road in the screen 60 will move to the centre, and the driver can use this as a cue to straighten the steering wheel 94, as will be required to keep

the combination straight. This is possible since the view from the rear view cameras seen by the driver is a "real" rear view, and not a "mirror" view.

Referring to Figure 25, if, while the vehicle 10 is reversing and steering to the left as shown, the steering angle rises above a predetermined angle, it may become impossible for the combination to be straightened by continued reversing of the vehicle 10 if the combination starts to jack-knife. The driver therefore needs to move the vehicle 10 forwards to prevent jack-knifing.

The trailer 12 is coupled to the vehicle 10 at the towball 14 and it is therefore possible to exert forces along the longitudinal axis of the trailer 12 and also along an axis perpendicular to this axis. Forces along the longitudinal axis serve to move the trailer forwards or backwards whilst the perpendicular forces rotate the trailer. Once the trailer angle increases beyond a certain critical angle the path of the towball 14 can not be steered so as to reduce the angle between the trailer 12 and the vehicle 10. It becomes impossible to straighten the vehicle – trailer combination due to not being able to exert forces in the desired directions without first moving forwards.

The control unit 16 is able to provide advance warning of possible jack-knifing by processing information received from the wheel sensor 42 and the trailer angle sensor 47. The control unit 16 determines from these signals the trailer angle, the rate of change of trailer angle with time and the distance travelled by the vehicle. It processes this information at regular intervals, for example, every 0.5m, to ascertain whether jack-knifing will occur. If the calculations of the control unit 16 predict jack-knifing, the alarm 59 sounds repeatedly once the vehicle-trailer combination comes within a predetermined, specified angle of the critical jack-knifing angle, alerting the driver that it is necessary to drive forward to successfully continue the manoeuvre. If the combination comes with a second predetermined, specified angle of the jack-knifing angle (closer than

the first), the control unit 16 controls the brakes 58 to bring the vehicle 10 to a gentle halt, and the right steering cue 92 is shown in the screen 60 as shown in Figure 26 to indicate to the driver that he needs to steer to the right. Then, when the required steering angle has been reached, the alarm 59 sounds once and the display on the screen 60 is changed to indicate that the driver needs to move the vehicle forwards as shown in Figure 27. As the vehicle is moved forwards, steering to the right, the trailer angle will decrease. When it reaches an angle from which the reversing can again be successfully completed, as shown in Figure 28, the control unit 16 again brings the vehicle 10 to a gentle halt and the screen 60 indicates that the steering wheel 94 needs to be turned to the left as shown in Figure 29. When the steering angle required to manoeuvre the vehicle 10 and trailer 12 combination into the target entrance 90 is reached, the screen displays an indication to the driver to select reverse as shown in Figure 30. It is possible during either the forward or reverse direction movement that the vehicle is brought to a halt due to the detection by the sensors 18, 20, 22, 24 of an obstacle. In this scenario, the system will recalculate a path using a shunting manoeuvre involving a plurality of forward and reverse movements as necessary.

Referring to Figure 31, if while the vehicle 10 is reversing and steering to the left as shown, the steering angle needs to be revised, for example, due to previous deviations from the system instructions, the driver may press the right switch 72 (as shown in Figure 32) to indicate this need to the system. The control unit 16 next controls the brakes to bring the vehicle 10 to halt and a revised left steering cue is provided on the screen 60 (not shown). The subsequent turn will be much sharper in order to successfully manoeuvre the trailer 12 into the entrance 90. Alternatively, the driver may initially apply the brakes in order to bring the vehicle 10 and trailer 12 combination to a halt before pressing the right switch 72 in order to obtain the revised steering cue as outlined above. When the required steering angle has been reached the alarm 59 sounds once and the display on the

screen 60 is changed to indicate that the driver needs to reverse the vehicle 10. When the trailer 12 is aligned with the target entrance 90 as seen through the display 60 shown in Figure 33, the driver brakes the vehicle 10 and presses the straight switch 68. The system then provides application of the brakes to bring the vehicle 10 to a halt and sounds the alarm 59 to indicate the provision of further steering cues as previously described to align the vehicle 10 and trailer 12 combination within the entrance 90.

Referring to Figures 34 to 36, if a manoeuvre is prohibited because the control unit 16 cannot plot a suitable route due to the possibility of collision with a vehicle 82, the kerb 80 or any other obstacle due to its proximity, lateral repositioning of the vehicle 10 and trailer 12 is required prior to reversing to provide adequate clearance on the outside of the turn. The system cues the driver to alter the steering angle to the left using the arrow 98 as shown in Figure 35. As previously the arrow 98 includes a band 100 to indicate the degree of steering required. When the wheel has been turned sufficiently, the display changes prompting the driver to move forwards as shown in Figure 36. Prior to this, it may first be necessary to reverse backwards in a straight line depending upon other obstacles in the vicinity of the vehicle 10 (as indicated by arrows A and subsequently B in Figure 34). Following movement of the vehicle 10 along the direction of the arrow B, the system automatically applies the brakes to bring the vehicle 10 to a gentle halt at a position from which a successful reversing manoeuvre can be achieved.

Referring to Figure 37, it may become apparent to the driver that a manoeuvre has gone wrong. This may be due to poor targeting (i.e. wrongly positioning the cursor on the display screen 60), the lateral position of the trailer 12 being too close to the entrance 90 or the trailer 12 being too large, amongst other things. If the manoeuvre goes wrong, the driver may stop the vehicle 10 and drive forward. This applies in a situation such as that shown in Figure 37 where it would be apparent to the driver that the

manoeuvre has gone wrong from the display on the screen 60 which is a view from the rear cameras 34, 36 of the trailer 12 (as shown in Figure 38). Whilst driving forward, the control unit 16 continually monitors the position of the vehicle 10 and trailer 12 combination in relation to the obstacle map. The system assists in repositioning for the subsequent attempt at the manoeuvre by automatically bringing the vehicle 10 to a halt when the position and orientation of the vehicle 10 and trailer 12 combination will permit reversal into the target entrance 90. If further obstacles are detected at this stage, the obstacle map is updated accordingly and the feasibility of a manoeuvre may be re-assessed by the control unit 16. If the vehicle 10 and trailer 12 combination is driven forward beyond the original targetting point, the brakes are automatically applied to bring the combination to a halt. This allows the driver to be in a position to re-enter the entrance 90 as a target using the cursor as previously described. Steering cues are then provided to drive the vehicle 10 to a position suitable for commencing a reversing manoeuvre and subsequently for the reversing manoeuvre itself.

Referring to Figures 39 and 40, the fixed cues 64, 66 may be used to reverse a vehicle 10 and trailer 12 combination along a road. In this scenario the fixed cues 64, 66 are constantly illuminated and are used as guides to aid reversal which is essentially directed by the driver. Whilst reversing, an upcoming bend may require a rapid and sharp reversal of steering angle as the angle between the vehicle 10 and trailer 12 increases. The system can provide an automatic brake application to reduce the speed at a predefined vehicle 10 trailer 12 angle as measured by the trailer angle sensor 47. Subsequently the speed of the vehicle 10 is limited until the trailer angle sensor 47 detects that the trailer angle has fallen below the predefined value. If the angle is approaching the angle necessary for the vehicle 10 and trailer 12 combination to jack-knife, the vehicle 10 may be brought to a gentle halt. As previously described, once the driver sees that

the trailer 12 is aligned in the desired direction, the straight switch 68 can be pressed to bring the vehicle 10 to a halt and obtain further steering cues.

Referring to Figures 41, 42a, 42b, 43a, 43b and 44 a reversing aid system according to a second embodiment of the invention includes a driver interface mounted in the passenger compartment of the vehicle within easy reach of the driver including driver input means 198 having a rotatable input member 200, a "straight" button 202 and a "hold" button 204 within the rotatable input member 200. This system further includes driver prompts in the form of indication lights 206, 208 and a forward prompt 210 mounted on wing mirrors 212 of the vehicle.

The system of this embodiment does not include the obstacle mapping mechanism of the system of the first embodiment, nor the identification of a target entrance by the control unit. Instead a driver prepares for a left turn simply by rotating the rotatable input member 200 one click towards the left. The system then issues appropriate prompts by the illumination of either light 206 or light 208 to indicate to a driver the necessary rotation of the steering wheel required to perform such a manoeuvre. Figures 42b and 43b show how a driver is prompted to turn the steering wheel by the illumination of lights 206 and 208 as shown in Figures 42a and 43a. If a driver is required to drive forwards during a manoeuvre the forward prompt 210 is illuminated. The system of this embodiment does not include entrance targeting and instead is more reliant upon the driver realising when exactly to start turning and when a turn is too sharp or too shallow. The straight button 202 is used similarly to the first embodiment when a trailer being reversed is aligned with an entrance into which it is to be reversed. During any manoeuvre rotation of the rotatable input member 200 will cause prompts to be re-evaluated i.e. if a turn is required to be sharpened, for example. If the radius of a turn is as required by the driver, the hold button 204 may be pressed to inform the system that the radius of the turn is suitable and prompts will then be issued to maintain this radius

of turn. It will be noted that in this embodiment of the system prompts for the driver do not indicate the degree of steering required to complete a manoeuvre. This encourages the driver to use their own skill and judgement, which may be preferred by some drivers.

Referring to Figure 45, in a third embodiment of the invention the vehicle steering aid is fitted to the vehicle 10, not towing a trailer. Features of the system corresponding to those in the first embodiment are given the same reference numeral increased by 100. In this case there is no trailer angle sensor and no rear view video cameras. Instead, rearwardly facing distance sensors 134, 136, are mounted on the rear of the vehicle, one on each side. The rear lateral distance sensors 122, 124 are also mounted on the vehicle which allows the sensors 122, 124, 134, 136 to be in direct communication with the control unit 116, without the need for RF transmitters or receivers as required in use with a trailer. The obstacle mapping is present in this system and it can be used, for example, to help the driver to reverse into a parking space. This can be achieved either by simply warning the drive if the vehicle comes close to an obstacle identified in the map, or by allowing the driver to identify a parking space by means of an input similar to that described above for the first embodiment of the invention.

As an alternative form of parking space identification the inputs of the interface shown in Figure 2 can be used to identify a parking space at the side of a road that the vehicle is driving along so that a parallel parking manoeuvre can be performed. For example operation of one of the left and right buttons, 70, 72 can be taken as an indication that the parking space is adjacent to the vehicle to the left or right or indeed in any other suitable position relative to the vehicle. The system can then guide the driver to drive the vehicle forwards to a position from which the manoeuvre can successfully be completed and then reverse into the space.

Referring to Figure 46, in a fourth embodiment of the invention, a driver interface is mounted in the passenger compartment of the vehicle within

view of the driver. The driver interface comprises a rectangular screen 300, two arrows 302, 304, one on each side of the screen 300 pointing away from it in opposite directions to form fixed cues to be used as described above. A forward prompt LED 306 is provided on the interface above the screen 300. A plurality of left indicator lights 308 are provided on the interface to the left of the screen 300 and a plurality of right indicator lights 310 are provided to the right of the screen (see Figure 46). The indicator lights 308, 310 are selectively illuminated by signals from the control unit 16 to indicate to the driver the direction of steering required. There is a proportional element to the indicator lights 308, 310 - a greater number of illuminated indicator lights 308, 310 indicating a greater required degree of steering.

Various modifications may be made to the present invention without departing from its scope. For example, any type of sensory prompt, for example, audible prompts may be provided instead of, or in addition to, visible prompts for the driver. The vehicle steering aid may be used with any vehicles, particularly long vehicles, not necessarily having trailers. Different orientations and layouts of the driver interface may be provided.

CLAIMS

1. A vehicle steering aid system including display means comprising indication means for indicating to a driver of the vehicle an action to be performed in order to perform a desired manoeuvre, a camera arranged to provide a camera view of the vehicle's surroundings, wherein the display means is arranged to display the camera view and steering correction cues, the steering correction cues being arranged to provide an indication to the driver of the direction of steering required when the vehicle is reversing to align the vehicle in a required direction, by means of reference to the camera view, and wherein the steering correction cues include a proportional element to indicate the amount by which the vehicle's steering wheel should be turned to perform the desired manoeuvre.

2. A system according to claim 1 or claim 2 wherein the steering correction cues comprise left and right steering cues.

3. A system according to any foregoing claim arranged to operate during a reversing manoeuvre.

4. A system according to any foregoing claim arranged to be used with a vehicle-trailer combination.

5. A system according to claim 4 comprising at least one camera mounted on the trailer.

6. A system according to claim 5 wherein the camera is rearwardly facing.

7. A system according to any foregoing claim, the steering cue including a proportional element to indicate the amount by which the steering wheel should be turned to perform the desired manoeuvre.

8. A system according to any preceding claim wherein the proportional element comprises a band, the width of which varies with the amount by which the steering wheel should be turned to perform the desired manoeuvre.

9. A system according to any of claims 1-7 wherein the steering cue comprises a plurality of selectively illuminated left indicator lights and a plurality of selectively illuminated right indicator lights, such that the proportional element is provided by the illumination of a differing number of lights.

10. A system according to any foregoing claim wherein the display means is further arranged to display a gear selection cue to indicate to the driver the desired direction of travel of the vehicle to perform the desired manoeuvre.

11. A system according to claim 10 wherein the desired direction is forwards or backwards.

12. A system according to any foregoing claim wherein the display means is mounted on an external mirror of the vehicle.

13. A system according to any of claims 1 to 11 wherein the display means is provided inside the vehicle.

14. A vehicle steering aid system substantially as hereinbefore described with reference to the drawings.

Application No: GB0400825.6 **Examiner:** Mr Stuart Purdy

Claims searched: 1-14 **Date of search:** 24 May 2004

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular reference
Y	1-4, 7-11 & 13	EP1253065 A (MATSUSHITA) see figures and page 6 lines 47-55, page 7 lines 52-54 and page 9 lines 20-25;
Y	1-4, 7-11 & 13	DE19910153 A (GEHRKE) see abstract and figures
Y	1-3, 7, 8, 10, 11, & 13	JP11025700 A (TOYOTA) see abstract and figures, in particular figure 1;
Y	1-4, 7, 9, & 13	US5097250 A (HERNANDEZ) see in particular figure 8 and column 4 lines 11-53;

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC[W] :

B7H; B7J; B7T; G1F; H4D

Worldwide search of patent documents classified in the following areas of the IPC[07]

B62D; G01S; G05B; G08G

The following online and other databases have been used in the preparation of this search report

WPI, JAPIO & EPODOC

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